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DoD SYSTEMS AND EQUIPMENT
PRODUCTION PLANNING GUIDE

TASK 68-14

February 1969

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DoD SYSTEMS AND EQUIPMENT
PRODUCTION PLANNING GUIDE

TASK 68-14

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ACKNOWLEDGEMENTS

This guide was developed at the request of the Assistant Secretary of Defense (Installations and Logistics). Logistics Management Institute performed the task in close coordination with DoD and industry personnel.

Many production planning innovations and publications contributed by industry and agencies within the DoD have influenced the contents of this guide. Recognition is also due those personnel in DoD and industry who were instrumental in providing source material for LMI Task 66-15, "DoD Systems and Equipment Integrated Logistics Support Planning Guide,"¹ and LMI Task 68-13, "A Manager's Guide to the Acquisition of DoD Systems and Equipment." Both were forerunners of this guide and are essential to establishing the production program interfaces described herein.

¹Available as DoD Guide 4100.35-G, "Integrated Logistics Support Planning Guide for DoD Systems and Equipment."

FOREWORD

This guide describes typical project management activities and key decision points essential to effective production planning for the manufacture, test, delivery, installation, demonstration, and industrial support of DoD systems and equipment. This type of production planning is necessary for continued preparedness to meet our defense commitments. The guide outlines a systems approach to the planning and integration of systems and equipment design, production, and logistics support. It describes typical relationships among project management and subordinate elements throughout the equipment life cycle. All of the production planning events and their relationships form a pattern from which project and other managers within the Department of Defense and industry can selectively tailor program networks.

The guide provides a "kit of tools" for use by production specialists and other interfacing program personnel. It is intended to assist them in defining plans, actions, and interfaces tailored to specific programs. While the guide is not intended to be incorporated in a contract, it does provide a checklist of contract considerations for both government and industry planning. Application of the guide will depend upon such factors as the mix of existing versus newly designed equipment and the degree of government and industry involvement in various phases of a program.

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FIGURES

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1. INTRODUCTION TO PRODUCTION PLANNING

Defense components and industry have developed many new production and production planning concepts during the past twenty-five years. As part of a systems approach to weapon systems project management, these many new concepts require actions which will integrate production management activities to achieve an appropriate balance between equipment performance, availability and cost. The purpose of this guide is to identify the interrelated activities that will provide an integrated systems approach to production management. It places production activities in perspective with mission objectives and such varied functional management disciplines and techniques as systems engineering, procurement policies, life cycle costing, configuration management, value engineering and cost reduction, quality assurance, status and requirements reporting, and other functional and administrative directives and procedures (see Figure 1).

The guide places emphasis on the planning actions required to place equipment design into production and outlines efficient time phasing for production activities. It provides for continuous schedule balance among all production management elements,¹ actions, and resources. The guide provides a "roadmap" of the key project actions and decision points in the life cycle of a typical major equipment program. It is intended as a reference document for use in planning for production. It derives its basic structure from existing DoD objectives, policies, and directives.

¹A list of elements for production is provided in paragraph 1.2.

THE PRODUCTION MANAGEMENT MISSION IN PERSPECTIVE

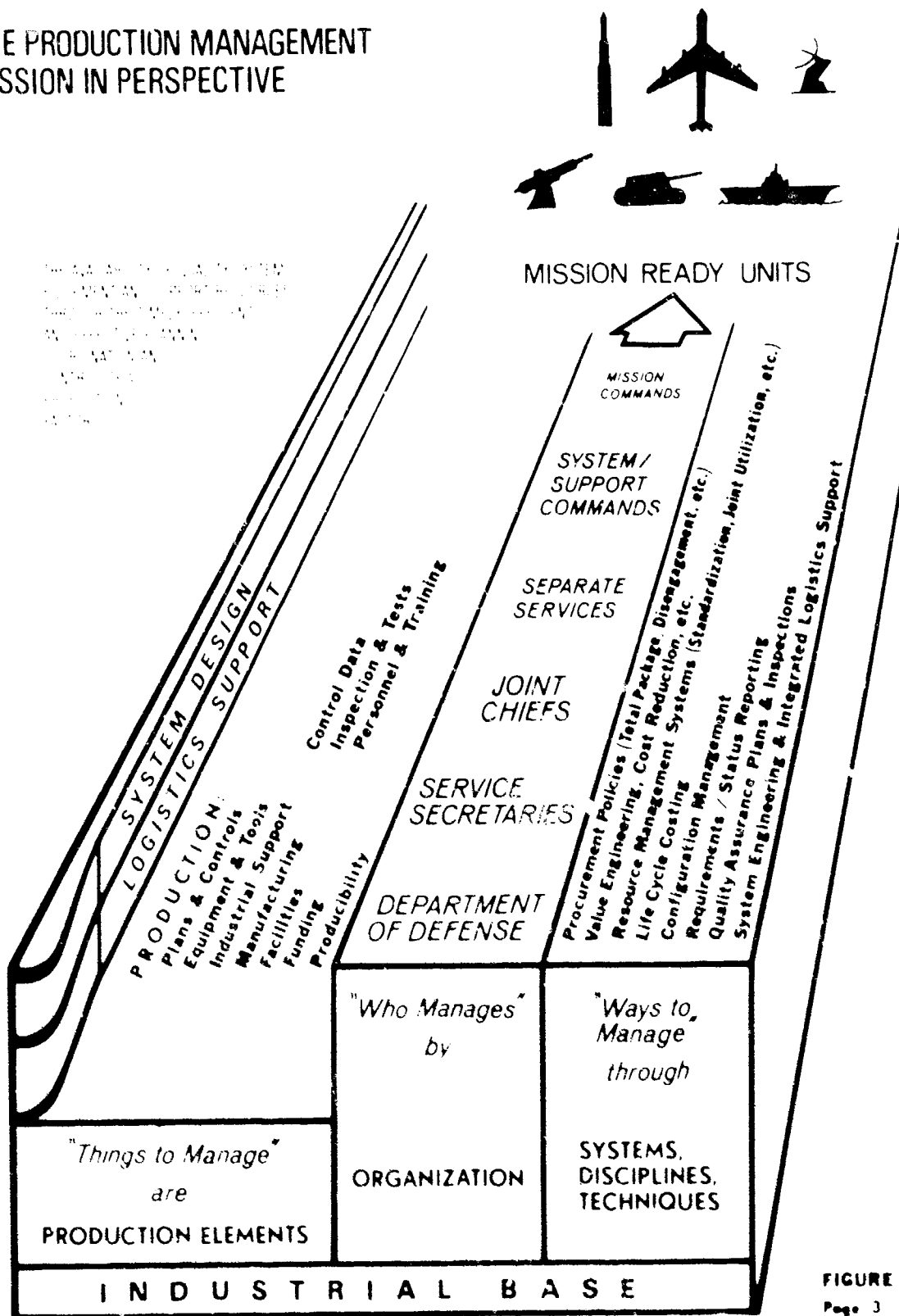


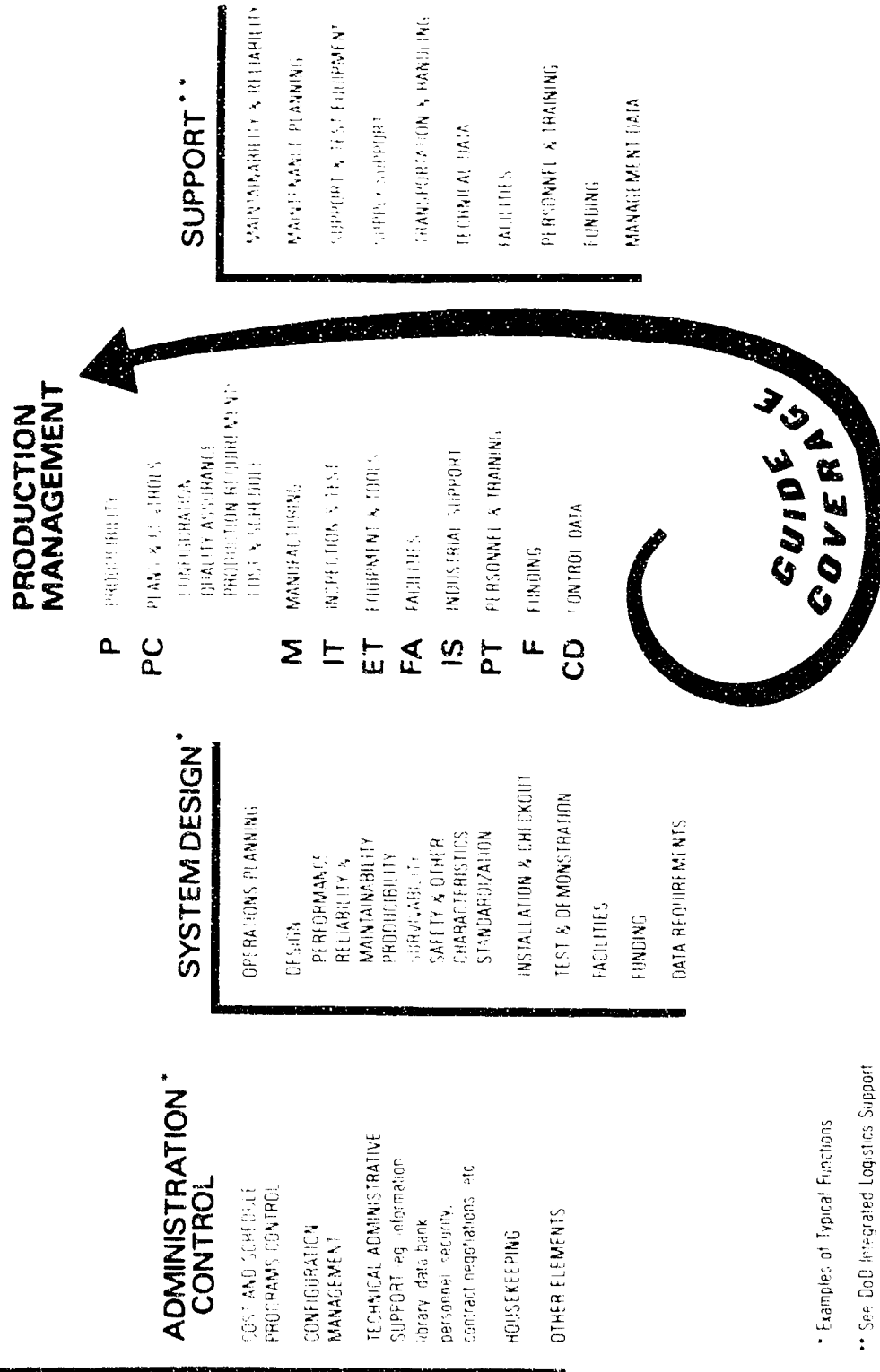
FIGURE 1
Page 3

In essence the guide describes the project management task of integrating production planning wherever needed in an equipment life cycle. Production planning, as a part of project management, is the integration of elements and events necessary to systematically define, coordinate, and direct all activities and influences so that quality systems, equipment and supporting resources will be produced on time and at reasonable cost. Figure 2 outlines the basic elements that are part of production management. It also lists comparable elements that are typical of the system design, support, and administration and control functions.

The guide covers the interfaces among system design, production, and logistics support management (see Figure 5). It structures production activities and responsibilities in a logic flow that provides continuity in the systematic development, production, operations and support of weapons and equipment. The maintenance of the interfaces and continuity among activities is essential to accomplishing new equipment procurements where program objectives call for high availability and readiness at low cost. The guide emphasizes the schedule balance and control of resources and data among the subcontractor, contractor, service projects, command units, and other areas directly connected with the production-to-use process. This emphasis is intended to assure sufficient visibility for management decisions on impending changes and program rescheduling (see Figure 3).

Review of the many service, industry, and other documents and handbooks relating to production led to the realization that terminology and lack of continuity in the description of production planning actions were impediments to a clear picture of production management. This resulted in the necessity to use

WEAPONS OR EQUIPMENT PROGRAM PROJECT MANAGEMENT FUNCTIONS



* Examples of Typical Functions

** See DoD Integrated Logistics Support Planning Guide (DoD 4100.3-5 G)

FIGURE 2

SCHEDULE BALANCE FOR MANAGEMENT

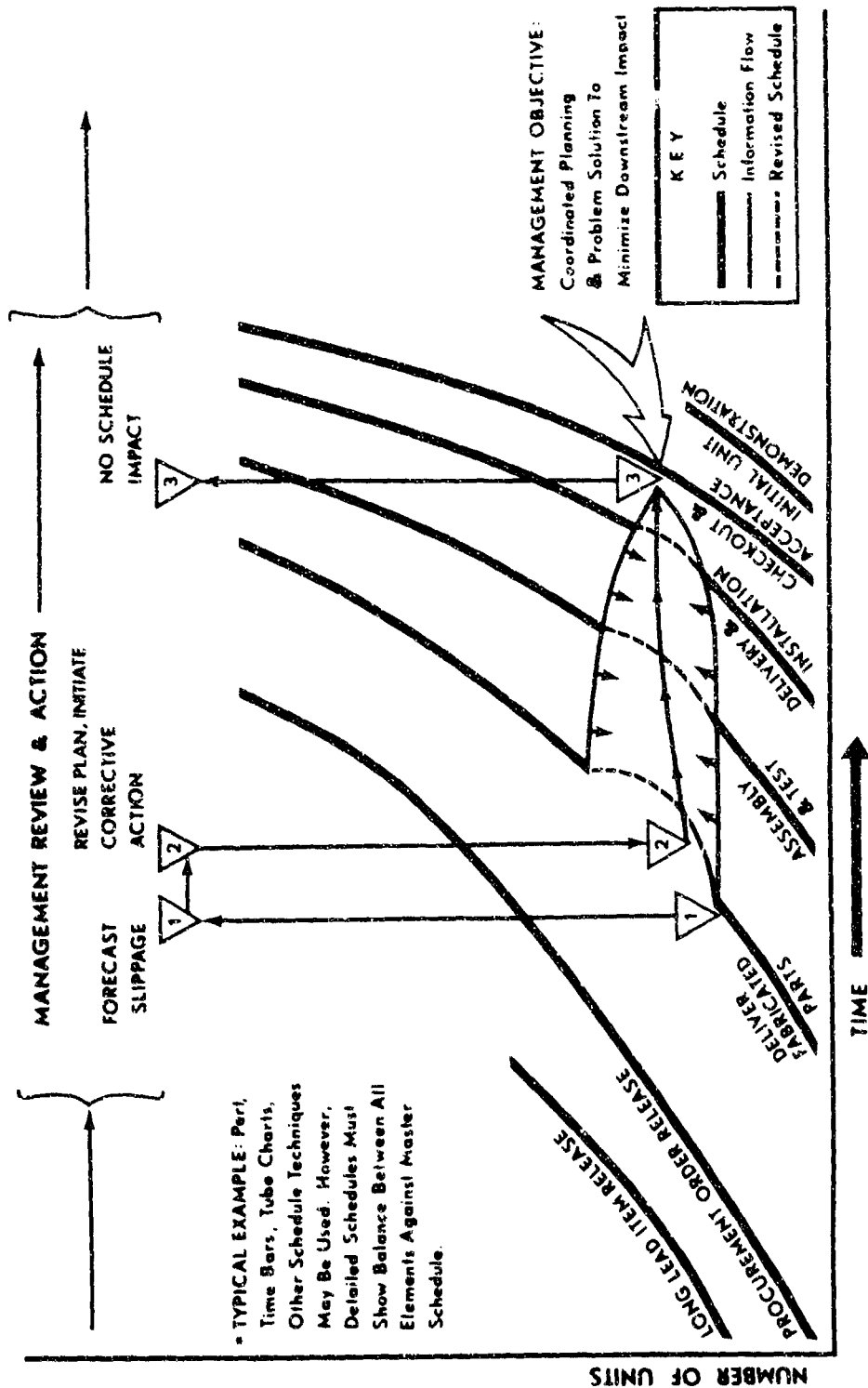


Figure 3
Page 6

common terms and to structure a typical planning events network.

Some terms may be used in the context of this guide in a manner unfamiliar to those who are more familiar with meanings peculiar to a specialized technical or management discipline. To prevent misunderstanding, an attempt has been made to use dictionary meanings in lieu of technical jargon.

1.1 APPLICATION

Integrated planning for production will provide visibility of the actions and decisions essential for improving life cycle costing, value engineering, and systems engineering analysis trade-offs. Such integrated production planning facilitates achievement of lower cost per equipment unit use throughout the life cycle of the weapons system. Inclusion of producibility criteria in the functional, design, and production baseline specifications will improve control of major costs and provide the contractor with better plans and contract specifications. The guide specifically recommends a systematic analysis of the production requirements and considerations with the system design and support requirements for their interdependent impact on each other. This analysis is progressively accomplished during the concept formulation, contract definition, development, and early production phases. The pattern of planned actions and decision points described in this guide is designed to minimize later costly changes to hardware resulting from modifications during the operational time period. The guide places emphasis on production planning early in the equipment life cycle where potential benefits from feasibility studies and trade-offs are at a maximum (see Figure 4).

IMPACT OF EARLY PRODUCTION PLANNING

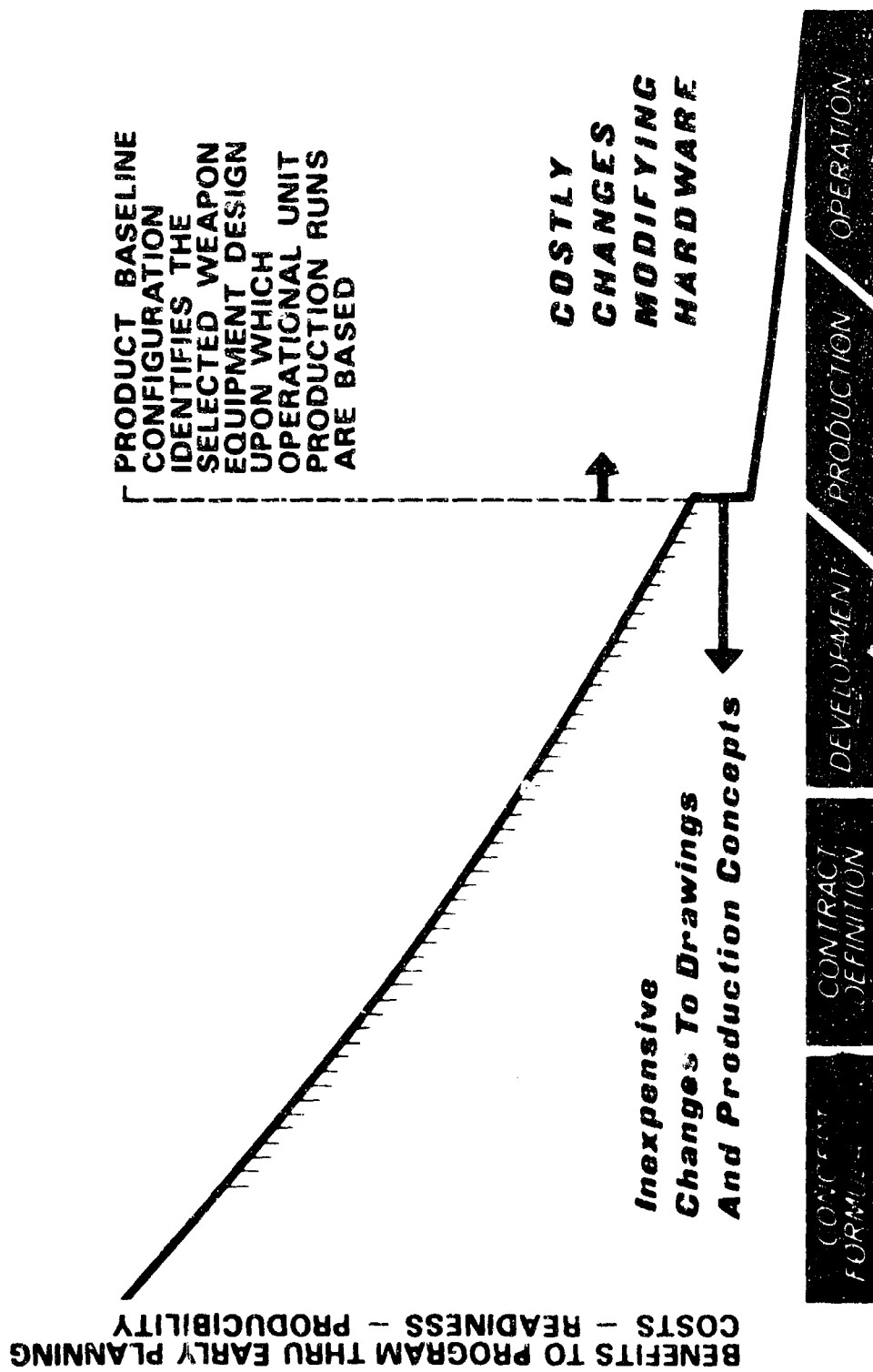


FIGURE 4
Page 8

The guide describes discrete management actions which are performed by contractor or military program managers. Program plans and contracts must specify the assignment of responsibility for these actions. Only key program actions and approval points for systems and equipment of average complexity have been included in the production planning network. They would require simplification for off-the-shelf or minor equipment procurements and expansion and elaboration for more specialized and complex systems. The guide provides a check list of the actions and decision points for each element of production management. Each military project manager and industrial contractor should tailor his production to accomplish the activities and events outlined by this guide. Procedures and interfacing procurement practices must be screened for selective application to the program. Compatibility, clarity, and simplicity must be the goal.

1.2 PLANNING FOR PRODUCTION DURING THE EQUIPMENT LIFE CYCLE

In order to provide a pattern for an integrated planning approach to production, the following elements were selected as part of a basic model:

- | | |
|---------------------------|-------------------------------|
| o Producibility (P) | o Plans and Controls (PC) |
| o Manufacturing (M) | o Inspection and Test (IT) |
| o Facilities (FA) | o Equipment and Tools (ET) |
| o Industrial Support (IS) | o Personnel and Training (PT) |
| o Control Data (CD) | o Funding (F) |

Certain departments and agencies within the Department of Defense may classify elements of production management differently. Such differences are of secondary importance as long as two basic requirements are met. The breakdown used must include consideration of all required production management actions, and

the elements chosen must be function and product related to permit their assignment to task-oriented individuals and organizations. The element breakdown must allow tangible events and activities to be structured for program action. They need not contain or describe techniques or disciplines concerning "how" to accomplish each event. Information on how to accomplish the production planning tasks may be found in many available production handbooks¹ and other government and industry documentation.

The elements, events, and decision points described herein are functionally related and do not indicate assigned organizational relationships. Those relationships for each project or program should be defined in the implementing documentation. The clear assignment of responsibility for accomplishing the activities outlined in this guide is one of the most important functions of production management. When accompanied by similar clear assignment of responsibility in the design and logistics support areas, such action insures a complete and integrated approach to acquisition management.

Figure 5 outlines a systems engineering approach to integrating the project management functions of support and production with system design. Key life cycle events for each of these functions are depicted. A summarization of these events for each phase of the life cycle follows:

o Concept Formulation: Production planning activities begin with the definition of top level functions and requirements needed to satisfy a required operational capability; e.g.,

¹For example, the Production Handbook, 2nd Ed., as edited by Gordon B. Carson and published by the Ronald Press Co., New York, in 1958.

weapon system or equipment. Included in a required operational capability document is an estimate of the current production capabilities which may be considered in alternative equipment concepts. These trade-offs may be among existing competing capabilities or among proposed new processes designed to produce equipment which cannot be manufactured by existing production capabilities. The best of the production concepts are selected and included in the Five-Year Defense Program along with the prime equipment and support concept selections. The selected concepts, together with the requirements to be levied on the contractor for contract definition, are included in a production plan requirements section within the system development plan. Management should provide for continued use of production planning personnel who participated in concept formulation during contract definition to assure continuity of production planning. The preservation of technical competence and continuity of experience through all life cycle phases are major factors in avoiding unnecessary expenditures. Management prerogatives available within all DoD and contractor areas to maintain such continuity in project management planning include: (1) insuring policy and procedure compatibility between the functional and project organizations; (2) establishing personnel policies which make efficient use of experience through training and reassignments between production planning and production organizations; (3) implementing effective procedures for the timely collection, analysis, and dissemination of management, performance, and historical data; and (4) judicious use of contract representatives, contract technicians, consultants, and other services.

• Contract Definition: Production planning activities are based on the production plan requirements in the system development plan. The technical and management requirements are combined to

provide guidance to the respective military and contractor project managers. These requirements must be included in requests for proposals. Evaluation criteria for contract definition and production contracts also are documented for subsequent use by source selection personnel. Contractor proposals should be evaluated for: (1) the degree to which they meet or exceed minimum requirements for production, (2) comparative credibility of their production cost estimates and impact on life cycle costs, (3) comparative producibility and risk of their manufacturing processes, (4) an effective plan for demonstrating the product against production specifications, and (5) the adequacy of their make/buy relationships. Successive iterations of the proposal activities often are necessary to select an optimum system and equipment design/support/production approach. The above actions result in general specifications for equipment and its production and support.

The selected contractor's production plan and detailed technical and management criteria for development planning are combined into a production plan for inclusion in the development contracts. Anticipated requirements for producibility, plans and controls, use and sharing of production equipment, tools and facilities, make or buy relationships, mix of contractor and government support and other production planning interface information are identified. Development contracts must define producibility requirements in terms of schedules, controls, responsibilities, product demonstrations, and test unit versus production run commitments.

Where the program requires state-of-the-art production only, the contract may be developed to cover production runs as part of a total package procurement. Where the program requires

advancing the state-of-the-art, the contract may be developed to cover only test units as part of development. Complex programs may require separate contracts of both types and later additional contracts for production runs of the advanced state-of-the-art equipment.

• Development: Production planning activities begin with the definition of detailed production concepts and requirements. These concepts and requirements are based upon the continuously evolving equipment designs and logistics support requirements. Production activities, times, locations, and the detailed requirements for equipment and tools, facilities, personnel, and data are refined. Production personnel participate in equipment design and logistics support reviews and demonstrations. They must evaluate all changes for their impact upon the production requirements. Design/support/producibility trade-offs are conducted. These trade-offs should consider the use of standard parts and materials, especially where the possibility of repetitive production exists. Program management approval based on these trade-offs results in the establishment of a proposed product baseline configuration and release of initial production contracts. Included within these contracts must be the specifications for and the means by which initial production hardware items are to be tested and approved. Depending on the type of procurement (e.g., total package procurement for development and production or procurement for development only), contracts at this point must define schedules, apportionments, responsibilities, and other requirements essential to follow-on production runs of the approved configuration items.

• Production: Planning activities start with the completion and release of detailed procurement specifications and cost

targets for hardware and supporting items. Limited quantities of these items are produced for test. A first article inspection is conducted to evaluate hardware and support items against their specifications. Acceptance of first article hardware and support items establishes a firm product baseline for follow-on production.

Production personnel evaluate changes resulting from service tests conducted in a preplanned operational environment. Production requirements are changed as a result of design/support/production decisions. Production resources are provided, as previously negotiated, to equip and support the first operating organization. Combined or separate government and contractor logistics support activities during this period are based on phaseover plans and schedules.

o Operation: Production activities continue in accord with phaseover plans, schedules, and previously negotiated contracts. Equipment and operational support changes made as a result of operational suitability demonstrations are reviewed for their impact upon production. All deficiencies are identified and evaluated by design/support/production trade-offs prior to making modification decisions. Production runs and operating unit support, if applicable, are modified and documented. The information is made available to future production of the configured items and to future weapon system and equipment planning. Production preparedness plans (e.g., mobilization to perform added missions, government plant production decisions, government/contractor production relationships) must continuously be updated with information which poses a change to equipment and support configuration. These changing plans are a part of the operational and system support command function and may cause new project action, extension of existing production and support

activities, or result in a phaseover of production due to technical advancements or mission changes.

1.3 USE OF THE GUIDE

This guide provides examples of production planning actions which are normally accomplished during the life cycle of a typical equipment project. It is a flexible document. It is intended as a tool for use by project managers in tailoring their own program actions and milestones to fit their own unique development requirements and funding limitations. These requirements will vary by system or equipment type (e.g., munitions, missiles, aircraft, tanks, ships, radar) and their complexity, as well as the degree to which government and contractors participate in each action. Procurement policies will have an impact upon how each program is conducted. In any case, a production of the composite of all production elements and all planned events will result in a more systematically defined, coordinated and directed production program.

Although the guide itself is not intended as a contractual document, its basic procedures are workable within the framework of existing policies and directives. Incompatibilities among this guide and existing policies and directives should be carefully evaluated to determine appropriate management action. Project managers and contractors should plan program action sequences based on as much of the equipment life cycle depicted by this guide as possible. This will assist in maintaining program continuity, especially where a series of contracts is needed to define and produce a system.

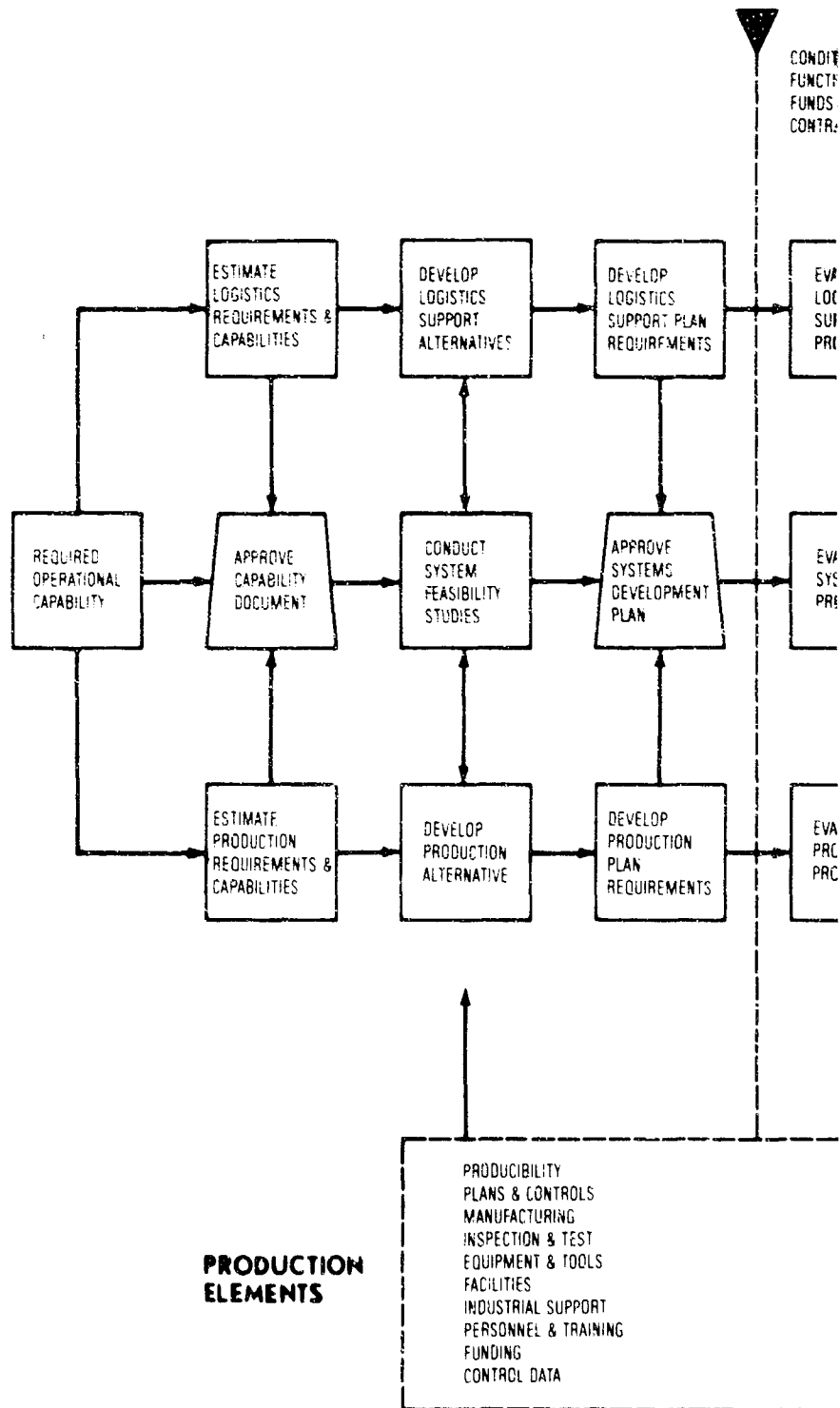
Chapter 1 has provided an overview of the purpose, application, and contents of the guide. Chapter 2 describes the system

design, support, and production management relationships necessary to the planning for production. The remainder of the guide describes the life cycle program events for the selected production elements. After reading this first chapter, the executive seeking a general understanding of the systems engineering approach to production planning should read the introduction to Chapter 2, paragraph 2.1, and review in detail the last foldout chart, Figure 6. This will provide an overview of the life cycle relationships among all production elements in terms of their specific actions as well as their interfaces with design engineering and logistics support. Production managers may find it convenient to read consecutively numbered action block descriptions as they follow the chart. The Chapter 2 descriptions cover the design engineering, production, and logistics support management level, and Chapters 3 through 12 cover the detailed production element level.

**SUPPORT **
MANAGEMENT**

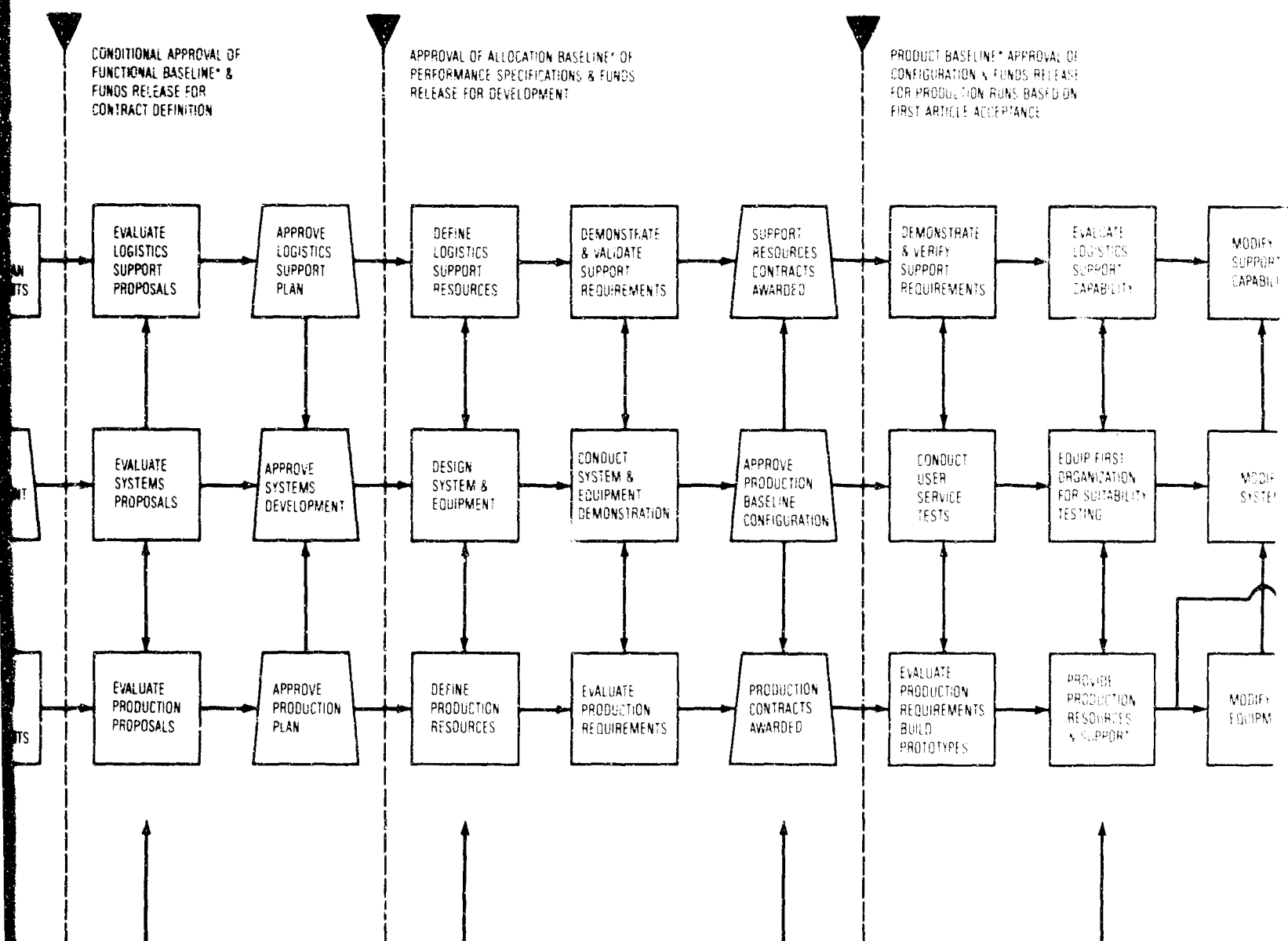
**SYSTEM DESIGN **
MANAGEMENT**

**PRODUCTION
MANAGEMENT**



**LIFE CYCLE
PHASES**

A



PLANNED SEQUENCE OF INTERRELATED EVENTS
SUPPORTING WEAPONS EQUIPMENT DEVELOPMENT
& PRODUCTION FROM CONCEPTS THROUGH USE

WARNING
SUCCESSFUL ACCOMPLISHMENT OF EVENTS
DEPICTED ABOVE DEPENDS UPON CLEAR
ASSIGNMENT OF RESPONSIBILITY FOR EACH
EVENT TO APPROPRIATE ORGANIZATION OR
INDIVIDUAL

**SYSTEM DESIGN & LOGISTICS SUPPORT
ALSO HAVE THEIR OWN SETS OF ELEMENTS
EXAMPLES ARE SHOWN IN FIGURE 2

B

KEY SYSTEMS MANAGEMENT EVENTS

A Systems Approach To The Integration Of Logistics Support And Production Planning Events With Weapons System And Equipment Design

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RELEASE
SED ON

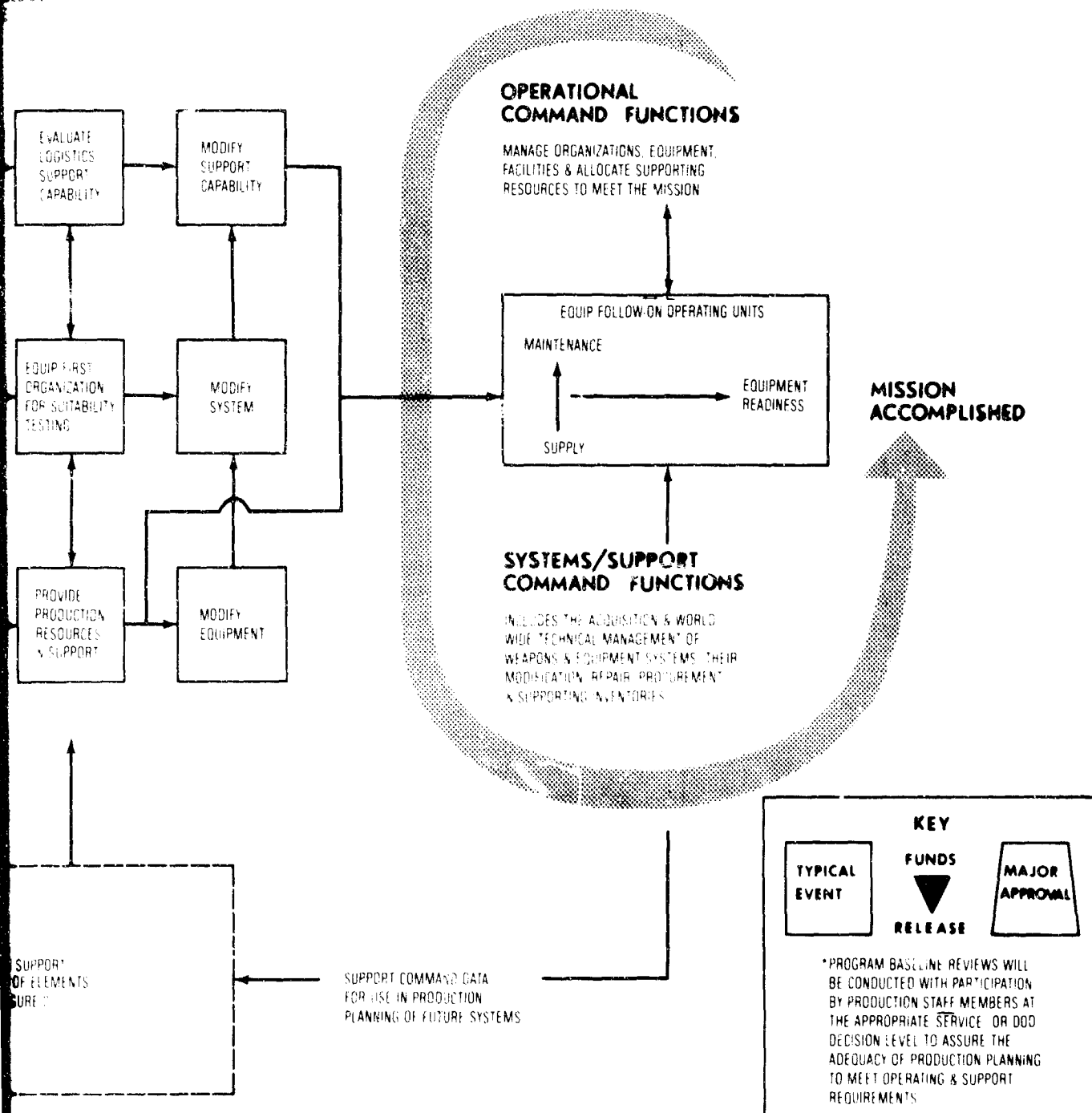


FIGURE 5

11

CHAPTER 2

SYSTEM DESIGN,
LOGISTICS SUPPORT, AND
PRODUCTION PLANNING INTERFACES

2. SYSTEM DESIGN, LOGISTICS SUPPORT, AND PRODUCTION PLANNING INTERFACES

2.1 INTRODUCTION

Planning for production of systems, equipment, and support resources requires a close and dynamic working relationship among system design, logistics support, and production management. It involves repeated review and refinement of the production requirements and their probable impact on current cost, cost in production, system design, and support planning. Figure 6 depicts the planning events typical of weapons systems or equipment of average or greater complexity. These events cover system design, support, and production management as well as selected elements essential to production planning. Together they form a pattern from which project and other managers within DoD and industry can selectively tailor their own program networks. The tailoring of each network depends upon such factors as the need for new equipment, the mix of existing versus new equipment, and the degree of government and contractor involvement in each event.

Qualitative and quantitative producibility characteristics, as well as operational characteristics, must be included in the system and equipment specifications. These producibility characteristics include materiel and machining standards, tolerances, and limits for design; the alternatives or selections for casting, forging, forming, riveting, and welding of materials and parts; the requirements for single versus multiple production line capabilities; inspection and test frequencies and durations; personnel skill restrictions and limitations upon design; and critical materiel risks based upon the most recent experience.

Also included are the control specifications for assuring these characteristics are considered in designs. The characteristics must be identified in a manner which will assure equipment producibility throughout its life cycle. Specified production characteristics must also be compatible with these portions of the specification which outline the operational and logistics support characteristics of the system. Especially important is a free flow of consultations among design, logistics, and production efforts to ensure effective use of parts standards, process standards, and performance standards. Coordinated management decisions, directives, and criteria implementing standardization objectives should be established as early in the production cycle as possible.

System identification, selection, programming, control, and evaluation of materiel, cost, and industrial resources must be accomplished throughout the production planning and production life span. Production management must assure that its subordinate elements:

- 1) Understand the mission, system and equipment;
- 2) Define actions and resources required for the complete production planning cycle such that designed equipment may be rapidly put into production without undue contract delays;
- 3) Schedule actions and commit resources to develop equipment and support future operations and logistics activities;
- 4) Apply the most recent and applicable techniques and disciplines for program assurance of quality, value engineering, schedule balance, and total production requirements identification;

- 5) Request and utilize funds in a preplanned sequence and maintain cost control to minimize production cost overruns and program delays; and
- 6) Use data and standard control techniques to maintain configuration accountability and an information and experience exchange among all project elements.

The following paragraphs describe the system design, support, and production management events typical of a weapon system or equipment program of average or greater complexity. They provide a systematic identification of actions prerequisite to achievement of the operational and support mission. It is recommended that the reader simultaneously review Figure 6 for complete visibility of the relationships among all events. System design and logistics support management events which occur at roughly the same time in the life cycle are described concurrently with the production management events to provide an integrated view of the project activities. System design and logistics support activities (SD and SM) are shown with titles in light underline. Production management activities (PM) are shown with titles in heavy underline.

2.2 DETAILED EVENT DESCRIPTION

SD-1 REQUIRED OPERATIONAL CAPABILITY

The system or equipment life cycle begins with the identification of an operational deficiency or the need for a new military capability. This required operational capability is usually defined by the nature of the threat, the anticipated operating environment, variations in basic mission and the constraints of policy, funding, gross schedule requirements, and

minimum system operational performance criteria (e.g., speed, range, capacity, firepower, target acquisition, vulnerability). These needs result in a tentative requirement for a new vessel, aircraft, missile, vehicle, communications systems or gear, or for multiple combinations of such hardware. These requirements must undergo screening and approval prior to further concept formulation action.

SM-1 DEFINE LOGISTICS SUPPORT CAPABILITY REQUIREMENTS

Support representatives must analyze the required operational capability to determine the logistics support capability needed. These capabilities should be stated in terms of (1) quantitative readiness performance criteria (e.g., system availability, utilization, permissible scheduled and unscheduled maintenance downtimes, operator and maintenance requirements in terms of gross skills and manning levels, firing rates, launch rates); and (2) qualitative readiness requirements (e.g., compatibility with existing replenishment techniques, operational unit self-sufficiency in remote areas, personnel skill level limitations, automated fault isolation techniques).

Support considerations are provided to the required operational capability document by (1) identifying the needed support capability, (2) proposing modifications to the operational requirements statement which will enhance overall effectiveness, and (3) recommending substitute capabilities or alternate solutions.

SD-2 APPROVE REQUIRED OPERATIONAL CAPABILITY DOCUMENT

The desired system capabilities (SD-1), the logistics support requirements (SM-1), and the current capability to meet these requirements (SM-2 and PM-2) are essential inputs for the

review and approval of the required operational capability document. These inputs provide information for mission analyses and preliminary design necessary to develop system concepts, technological approaches, and related cost and schedule information. Clear government and contractor study responsibilities for the development of requirements for schedule, costs, work breakdown structures, etc., must be made.

SM-2 ESTIMATE OF LOGISTICS SUPPORT CAPABILITIES

An integrated package of each support element's forecasted ability to satisfy support readiness requirements (SM-1) is prepared. For example, the package might include readiness performance experience together with lessons learned on previous similar systems including utilization, availability, incidence of unscheduled maintenance, causes of maintenance downtime, facility requirements, training requirements, technical data display techniques, fault isolation techniques, the benefits of tracking repair parts usage, and the maintainability goals to be considered from similar system and equipment design experience. Probable support requirements over and above existing capabilities are identified for further action.

PM-2 ESTIMATE PRODUCTION CAPABILITY

An estimate must be made of the current capability to produce the types of equipment being considered. It is based upon the operational and support requirements and capabilities (SD-2 and SM-2). This estimate will be based on data covering similar system or equipment production capacities, problems associated with producibility of past systems, experience on production emergencies or unscheduled field modification requirements, critical experience in achieving value and quality of product,

timing and impact of numerically controlled tools upon past development and production efforts, the problems associated with various types of materials and their availability, and the current availability of facilities and funds.

Where current production capability will not support the equipment under consideration, proposed or projected capability that may exist in time to support the program should be considered as part of the production capability estimate. Both government and industry proposed and projected capability should be considered. Program risks associated with planning production based upon proposed and projected capabilities should be identified.

SD-3 CONDUCT SYSTEM FEASIBILITY STUDIES

Based upon the approved operational capability document (SD-2) and implementing studies, several preliminary system and equipment ideas are developed to explore alternate ways of achieving mission objectives. System/cost/effectiveness trade-offs determine the optimum choice among the several system and equipment concepts. Logistics support and production requirements defined during these feasibility studies permit comparison between various life cycle cost alternatives. These studies may be summarized for program management review and should record selection rationale behind each considered concept. They include mission analyses trade-offs involving system and support selection, development cost and schedule estimates, production estimates, life cycle cost estimates, and preliminary performance specifications.

SM-1 DEVELOP SUPPORT ALTERNATIVES

The logistics support ideas incorporated in the system

feasibility studies (SD-3) consist of an integrated package of operational and economic trade-off results (e.g., equipment redundancy or high reliability versus maintenance upon failure) and selection of each element's best approach to overall support. Maintainability, reliability, and cost are the focal point for trade-offs combining system design alternatives with concept inputs from each support element. Failure to consider the combined trade-off alternatives can result in a support concept which leads to excesses and shortages, duplicate facilities, and poor use of existing capabilities. Use of simulation techniques and mathematical modeling as trade-off aids should be resorted to when complex problems are encountered. With proper design, the data base for simulation or mathematical modeling may be used later as a dynamic management data baseline.

PM-3 DEVELOP PRODUCTION FEASIBILITY ESTIMATES

Concurrently with the conduct of system feasibility studies and the development of support alternatives, production feasibility estimates should be made for each of the alternatives. These feasibility estimates should include consideration for using existing production techniques for each alternative being studied. They also should consider advanced production techniques available at that point in time and their risk to equipment production. Gross schedule comparisons and evaluations for alternatives should be made.

Requirements for critical raw materials, long lead production capabilities, and long lead system equipment should be carefully examined. Plans should be made for procurement and control of these items as soon as sufficient detailed identification is available. Specific control systems for configuration,

quality, cost, and schedules should be identified. The feasibility estimates should then become part of the overall system studies (SD-3).

SD-4A APPROVE PROGRAM CHANGE REQUEST

When a system concept is developed to the point where its technical and economic feasibility can be verified, a Program Change Request (PCR) is prepared to incorporate the selected program into the DoD Five-Year Defense Program. OSD approval is granted by a Program Change Decision (PCD).

SD-4B APPROVE SYSTEM CONCEPT FORMULATION PACKAGE

The system concept formulation package assures higher authority that the selected concept is the best way to satisfy the identified operational need and recommends the resources needed to pursue further development. The package contains a description of the proposed system, the costs and schedules, and the rationale supporting the concept selection. It provides for a preliminary program review prior to preparing a system development plan.

SM-4A PREPARE LOGISTICS SUPPORT PROGRAM CHANGE REQUEST

The logistics support section of the Program Change Request is prepared. This section should contain information on readiness performance goals (including maintainability and reliability design performance requirements), maintenance concepts, support impact on organizations, preliminary estimates of life cycle support costs, and major support development milestones.

SM-4B PREPARE SUPPORT CONCEPT FORMULATION PACKAGE

The selected support concepts (SM-3) are documented for

inclusion in the system concept formulation package (SD-4B). The package also includes the estimated costs and schedules, the concept selection rationale and the specific funding needed for further development. The package provides justification to the logistics approval authority for the selected concepts.

PM-4 PREPARE PRODUCTION PROGRAM CHANGE REQUEST

When preliminary production feasibility for the design concept has been verified, the production concept, cost estimates, preliminary schedules, and anticipated risk areas should be documented. This information consists of preliminary sketches, system level schedules and gross projections of anticipated production requirements and costs. These are included in the concept formulation package for the system (SD-4B).

SD-5 APPROVE SYSTEM DEVELOPMENT PLAN

The systems development plan is the functional baseline for further engineering development of performance specifications. The plan includes functional and technical descriptions of operations and support requirements, preliminary systems and equipment configurations, production concepts and requirements to be levied on the contractors, and trade-offs to be further considered. Emphasis is placed on areas of high technical risk, schedules, and life cycle costs. The plan also identifies funding requirements so that contract definition and further development budget allocations can be made. Acceptance of the Development Plan is a "Key Approval Action" requiring review and approval prior to contract and funding release by Service level or OSD authority, as appropriate to existing policy on weapons technology and dollar thresholds. Program reviews leading to this "Key Approval Action" should insure adequacy of planning for the

production of equipment and for the logistics support of operational maintenance activities. They must be conducted with participation by production and logistics staff members at the appropriate Service or OSD decision level.

SM-5 DEVELOP SUPPORT PLAN REQUIREMENTS

The support plan requirements are included in the system development plan (SD-5) and the request for proposals. These requirements include gross support functions that meet system or equipment requirements; the design and support goals in terms of performance, readiness and cost-to-produce criteria to be met during engineering development; support, operation and cost trade-off criteria to be considered; and support program management activities and decision points anticipated during subsequent development events. Specific inputs to the support plan requirements include maintainability and reliability requirements, maintenance support concepts, preliminary support equipment estimates and design criteria, and preliminary supply, facility, personnel and training, technical data, transportation, handling, packaging, schedule, life cycle cost and funding requirements. The support plan requirements should be clearly defined and quantified for "Key Approval Action" specified in SD-5. They should be included in the request for proposals.

PM-5 DEVELOP PRODUCTION PLAN REQUIREMENTS

Production plan requirements should be developed in consonance with the logistics support plan requirements for inclusion in the system development plan (SD-5) and request for proposals. They provide the basis upon which contractors can propose their production plans during contract definition activities. The depth of detail is dependent on the type of procurement and the

degree of configuration identification at that point in time. Production plan requirements must include the concepts and criteria for producibility, production plans and controls, inspection and test, facilities, equipment and tools, industrial support, personnel and training, data, schedules, value engineering, costs, and funding. Emphasis should be placed on production risk schedules, and cost estimates for the equipment life cycle. The requirements should be specified for both government and industry activities. Responsibilities and relationships should be identified. Consideration should be given to production quantities, mobilization policy, automated programming for tools and configuration management, quality, cost and schedule controls and flexibility. Funding requirements by major milestone also should be identified so that contract definition and further development budget allocations can be made.

SD-6A APPROVE SYSTEMS CONTRACT DEFINITION

An advance procurement plan initiating sole source or competitive contract definition for the selected system and support concepts is issued following approval of the development plan. Procurement and budget authorizations are provided to the development command in this management plan.

SD-6B APPROVE SUPPORT AND PRODUCTION REQUIREMENTS

As an integral part of the systems contract definition approval, support and production requirements are approved through direct coordination with responsible managers at all appropriate DoD levels. This approval is the basis for beginning development of the logistics support and production management plans.

SD-7A APPOINT SOURCE SELECTION AUTHORITY

Early contract definition effort consists of detailed

engineering to define operations and support performance requirements. This effort is aimed toward the preparation and approval of an "allocation" baseline for acquisition of the system and equipment. Contract definition may involve competitive proposals by several contractors. A source selection authority is appointed to provide DoD in-house evaluation of these proposals. Assistance is provided through representative staff elements of the Services. The purpose of this assistance is to help establish the source selection criteria.

SD-7B PROVIDE SUPPORT AND PRODUCTION REQUIREMENTS
TO REQUEST FOR PROPOSALS

The logistics support and production plans requirements (SM-5 and PM-5) provided as a part of the systems development plan (SD-5) are included in the request for proposals (SD-7C). It is of utmost importance that these requirements thoroughly define operational, readiness, and producibility specification goals. They also should specify the support and production management approaches to further development and acquisition of resources.

SD-7C REQUEST FOR PROPOSALS

The request for proposals is prepared for issuance to contractors. It contains results of prior studies and the current system specifications. Included are such key characteristics as performance, readiness, and producibility targets, with criteria for their further development, test, and demonstration. Required program management criteria include assignment of responsibilities and selective identification of specific portions of general directives, policies, and procedures that are to apply to the selected procurement approach. Complexity and cost of equipment

may require successive iterations of the request for proposals and proposal evaluation before contract definition can be completed.

Where appropriate, requirements for life cycle cost estimates should be included in final request for proposals. Program management should consider and define representative cost elements, time elements, and the simplest appropriate methodology to be followed by competing contractors in developing and updating life cycle cost estimates for (1) program funding and budget control and (2) cost of use (and ownership) comparisons. In simple equipment procurements, product use guarantees alone might satisfy these requirements. Similarly, where the contracts include contractor assumption of support responsibilities and associated costs, major life cycle cost elements may be already included in the cost of acquisition.

SM-7A DEVELOP LOGISTICS SUPPORT MANAGEMENT PLAN

The logistics support management plan is established to provide an outline of specific organizational responsibilities and functions for further development and acquisition of support resources and monitoring of contract effort. A separate plan for each support element program is included in the support management plan. The plan should identify organizational interfaces; define working procedures and personnel responsible for such things as implementation of the logistics support development program, monitoring of the contractors' value engineering, maintainability and reliability efforts; and establish policy regarding maintenance engineering practices and procedures for all levels of maintenance, development and acquisition of support equipment and facilities, procurement and distribution of spares and repair parts, implementation of the personnel and training

program, procurement and distribution of technical data, and implementation of the transportation, packaging, and handling program. The plan should include related funding, schedule and data management information, relationships and responsibilities between development and support commands, and designation of the logistics support manager.

SM-7B ESTABLISH LOGISTICS SUPPORT CRITERIA FOR
PROPOSAL EVALUATION

The logistics representatives on the source selection board establish criteria for evaluation of proposed support plans. These criteria include policies for determining how well each proposal meets readiness performance specifications and cost requirements, takes advantage of current resources, minimizes technological risks, and considers life cycle support costs.

PM-7A DEVELOP PRELIMINARY PRODUCTION MANAGEMENT PLAN

The preliminary production management plan should provide specific organizational responsibilities and functions for further planning and development of production resources. It should include policies for monitoring contract definition. Production element inputs identify organizational interface working procedures and personnel responsible for such things as:

- Implementation of the production resources development program;
- Monitoring of the contractor's producibility program effort;
- Monitoring the contractor's control-of-cost-in-production design targets;

- Establishing policy regarding plans, controls and analysis practices and procedures;
- Development and acquisition of production tools, equipment, and facilities;
- Procurement, control and distribution of industrial resources;
- Implementation of personnel and training programs;
- Identification and control of critical materiel items; and
- Funding and control data.

The management plan includes related cost and schedule information, the relationships and responsibilities among production, system design and support management, and designation of the production manager.

PM-7B ESTABLISH PRODUCTION CRITERIA FOR PROPOSAL EVALUATION

The production manager's representative on the source selection board establishes criteria for evaluation of contractor proposed initial production plans. These criteria include policies for determining how well each proposal meets its production specifications and cost requirements, takes advantage of current resources, minimizes risks, anticipates initial and follow-on production requirements, and estimates the cost for a complete production program.

SD-8 EVALUATE SYSTEM PROPOSAL - INCLUDING SUPPORT (SM-8) AND PRODUCTION (PM-8)

The source evaluation board reviews and scores each proposal based upon the previously established criteria. Subsequently, selected competing contractors continue to define the

performance requirements of the system elements and their plans for production, operations, logistics and training. The resulting system proposal is then evaluated. This final evaluation determines the technical soundness of the proposal in meeting performance requirements, degree of identified risk, contractor understanding of tasks in the proposal work statements and his ability to accomplish them, best features of each proposed design, support and production approach, costs and schedules, and comparative impact of proprietary rights.

SD-9A APPROVE SYSTEM DEVELOPMENT

Development plan specifications and terms (SD-5) constitute a functional baseline which the project manager uses as a negotiations floor. Improved specifications and more definitive terms may be incorporated into the contract as a result of proposals and negotiations. The updated plan includes procurement specifications and detailed demonstration methodology; equipment requirements and support and production element resource requirements (including government furnished items); cost and price estimates; and any special contract clauses. Review of the updated development plan is prerequisite to "Key Approval Action" by the designated project approval authority. This review endorses the plan as an allocation baseline for the development contract awards. It should include participation by logistics support and production staff members at the appropriate military or OSD decision level to insure adequacy of logistic support and production planning for producibility as well as maintenance and readiness of equipment in the operating environment.

SD-9B SELECT CONTRACTOR(S)

Upon approval of the system development, contractors are

selected. The selection is based upon the proposal evaluations (SD-8). Multiple contractors may be chosen, particularly for sub-systems development, under the direction of a system project office. High confidence in achievement of the required mission capability must be the first selection consideration. After specified operational performance, readiness, and producibility requirements are assured, other considerations may then be weighed.

SM-9 ESTABLISH SUPPORT DEVELOPMENT PLAN

Subsequent to the proposal evaluations, the logistics support portion of the system development plan is updated to reflect the results of contract definition. The support development plan also includes the updated management plan covering the controls, policies, funding, scheduling, etc., for development, acquisition, and distribution of the support resources. The support development plan is an integrated package of time-phased support element plans and requirements. It includes the maintainability and reliability requirements and related performance incentives, including value engineering incentives, and the maintenance concepts and the procedures for acquisition and distribution of support and test equipment, spares and repair parts, facilities, personnel and training, training equipment, government furnished materiel and technical data. It also includes updated funding and management data requirements and schedules for each support element identified by organizational responsibility. Approval of the support development plan is a part of the "Key Approval Action" specified in SD-9A.

PM-9 ESTABLISH PRODUCTION DEVELOPMENT PLAN

Subsequent to the proposal evaluations, the production planning portion of the system development plan is updated. It must

reflect the results of contract definition. These results include the production management plan covering the controls, policies, funding, scheduling and responsibilities for development, acquisition and distribution of required production resources. The production plan is an integrated package of individual time-phased production element requirements. It includes the following:

- Producibility requirements and related incentives;
- Production concepts and plans;
- Procedures for acquisition and distribution of common and special production tools and equipment, including their interchangeability and replaceability;
- Manufacturing processes and controls for numerical programming of tools, quality assurance relationships among production elements, and contractor-subcontractor relationships for make/buy;
- Procedures for inspection and test of hardware, from test and prototype through first article and production equipment;
- Procedures for acquisition and use of facilities;
- Procedures and controls for acquiring and using industrial support items including critical materials;
- Procedures for the government/industry interface, training and distribution of personnel to support all element activities;
- Updated funding and control data requirements;
- Production element schedules identified by organizational responsibility; and

- Procedures for changes in the production plan.

Approval of the production development plan is a part of the "Key Approval Action" specified in SD-9A.

SD-10A AWARD SYSTEM DEVELOPMENT CONTRACT

Based upon system development approval and contractor selection (SD-9A and B), the contracts are awarded.

SD-10B BEGIN DETAILED SYSTEM DESIGN

System and equipment specifications, including operational performance, readiness, and producibility criteria (design requirements), are the basis for detailed system and equipment design. Maintainability, reliability, and cost-in-production target parameters are included in the design considerations. Continuous coordination with support and production elements is required to assure that a proper balance is maintained between design performance and cost versus support and production requirements and their effect on equipment delivery and readiness.

SM-10 MONITOR AND GUIDE LOGISTICS SUPPORT EFFORT (Continuous)

Logistics support requirements for all elements are generated by detailed maintenance engineering analyses of evolving equipment designs. Initial provisioning documentation for spare parts, maintenance tools and test equipment, facilities, and other logistic support is released.

Maintenance engineering analyses, as part of the total systems engineering effort, influence design development through economic trade-offs among operational and support requirements. The maintenance analysis also uses design schematics and drawings

to define the basic support requirements. Support management should monitor continually and assure that each support element's requirements are properly generated, interfaced, and programmed to establish maintainability and reliability goals. The maintenance engineering analysis documentation system supports and controls this recurring analysis.

PM-13A BEGIN PRODUCTION DEVELOPMENT EFFORT (TEST UNITS)

The requirements needed to define production element resources for test units are generated by detailed engineering analyses of the equipment designs and support requirements. These analyses, as part of the total systems engineering effort, influence system design by reflecting the results of economic and operational trade-offs among equipment reliability, maintainability and producibility considerations. Production management guidance for all production elements is provided continually throughout all development activities. Production management should assure that each element's requirements are properly generated, interfaced and programmed to established producibility goals. The production engineering documentation system supports and controls this recurring analysis.

PM-10B INITIATE PRODUCTION PLANNING FOR OPERATIONAL UNITS

Concurrent with the production of the test units, planning for the operational units is begun. This continuing effort is aimed toward the establishment of the production definition plan (PM-11B). This planning encompasses design and support changes which occur during detailed design. It includes production changes resulting from subsystem and system testing. All changes are considered in the identification of material requirements. This effort is accomplished to provide a proposed product

baseline for follow-on production runs (PM-17B). Its accomplishment and timing are dependent upon the procurement method selected.

SD-11 COMPLETE DETAILED DESIGN OF SYSTEM/EQUIPMENT

System and equipment design is a continuing effort throughout the development phase. Subsequent reviews, tests, and demonstrations create a feedback of engineering changes and new requirements which in turn must be analyzed from an economic and operational viewpoint and programmed into a new design cycle. The typical feedback loop is shown in Figure 6. The impact of these changes on logistics support and production is included in this evaluation (SM-12B). The engineering drawings, specifications, test procedures, and other production engineering documentation become the basis for contractual control of each end item to be manufactured and tested.

SD-12 REVIEW AND APPROVAL SYSTEM DESIGN

Review and approval of system and equipment design is conducted at designated review milestones. Included are all aspects of design such as performance, maintainability, packaging, structure limitations, safety, standardization, as well as support requirements which have been generated based upon the design. Changes are incorporated in the engineering documentation and detailed specifications. Design review and approval results in concurrence of the development command to commit the design to fabrication of prototype models. It is also the basis for provisioning planning and preparing preliminary technical data.

SM-12A REVIEW AND APPROVE DESIGN CHARACTERISTICS AND SUPPORT ELEMENT REQUIREMENTS

Designs are reviewed and approved to assure that established quantitative and qualitative logistics support requirements can

be satisfied. Resulting changes and their impact on support requirements are reviewed for compatibility. Support management assures that the requirements of each element have been included and that full consideration has been given to available items in the DoD inventory.

SM-12B EVALUATE IMPACT OF PROPOSED SYSTEM AND/OR LOGISTICS SUPPORT CHANGES

Support management evaluates the impact of all changes on support. Trade-offs are made to develop alternative approaches to eliminate discrepancies by changes to the design, support, or to performance predictions. Coordination of trade-offs and choice of alternatives with design engineering and production is mandatory.

PM-12A APPROVE PRELIMINARY PRODUCTION REQUIREMENTS

All system and equipment designs are reviewed and approved to be sure that established quantitative and qualitative production requirements can be satisfied. Trade-offs, prime equipment changes, and logistics support changes are reviewed for their impact upon production. The production manager assures that the requirements of each production element have been included and that full consideration has been given to use of available items in the Department of Defense and industry inventories.

PM-12B EVALUATE THE IMPACT OF DESIGN/SUPPORT CHANGES

At the time of the design and support requirements review and approval, the production manager evaluates the impact of all changes on production. In cases where the design or changes to the design or support requirements do not meet producibility requirements, trade-offs are made to guide correction of discrepancies. Discrepancies may be due to such things as machine

tolerances, material fabrication processes, long fabrication and assembly times, excessive testing requirements, etc. Coordination of such change actions among production, design, and support management is required.

SD-13 CONDUCT SUBSYSTEM DEMONSTRATION

As the design and test specifications are being completed, subsystems prototypes are fabricated and tested. Performance to detailed specifications should be demonstrated. Wherever possible, support requirements are verified during demonstration. Results are evaluated and problems resolved.

SD-14 CONDUCT SYSTEM DEMONSTRATION

Demonstration of the prototype hardware system, value engineering design reviews, and other corrective actions should be accomplished while there is time to change specifications and still impact the system as little as possible. Verification of support requirements (SM-13) is part of the system demonstration. Corrective action results from the change activity (see change loop Figure 6, SD-11 through 14). The Government and contractor joint tests demonstrate: (1) system capabilities and limitations; (2) performance, control, maintainability, and reliability; (3) availability and validity of technical data; (4) compatibility of subsystems; and (5) adequacy of logistics support planning.

SM-13 and 14 CONDUCT DEMONSTRATION AND VALIDATION OF SUPPORT REQUIREMENTS

Support management assures that all support requirements and criteria (e.g., access provisions, technical data on the equipment, repair time limitations) have been included in the design and test specifications. In addition, prototype support

resources (e.g., test equipment, tools, technical data, handling equipment) are demonstrated to validate configuration and specification requirements. To the maximum degree possible, these demonstrations are conducted as an integral part of system tests to assure that all support requirements are reviewed prior to production release. Simulation models, laboratory tests, mathematical models, and actual field tests are used. Testing and validation continues until the total system capability is demonstrated.

PM-13 and 14 VERIFY AVAILABILITY OF HARDWARE (PROTOTYPE)

In preparation for the subsystem and system engineering test and demonstration, all prototype hardware and their supporting items are delivered for test. Production personnel support is provided.

SD-15 ESTABLISH PROPOSED PRODUCT BASELINE

Completion of system demonstration and incorporation of the resultant changes establishes the proposed product configuration baseline consisting of all the specifications necessary for initial production and first article testing.

SM-15 UPDATE SUPPORT PLAN

The support plan is updated concurrently with establishment of a proposed product baseline configuration. Due to long-lead item release to production and the frequent lag in support resource identification, limited commitment of some support resources may be required. Commitment of resources to production are coordinated with all support elements to insure compatibility of requirements and keep later changes to a minimum. Inputs to SD-15 include well-defined maintenance performance and measurement

criteria, drawings and specifications for support equipment and facilities, spares and repair parts lists and specifications, technical data by type and format, personnel, training requirements, training equipment funding allocation for production, and management data requirements.

PM-15A UPDATE PRODUCTION REQUIREMENTS

The production plan is updated concurrently with the establishment of a proposed product baseline configuration. At this time production management reviews the long-lead time releases for both hardware and support resources. Appropriate action is taken to commit time critical resources to manufacturing.

Commitment of all resources is coordinated with all production elements to insure compatibility of requirements. Coordination with system design and support management is necessary to assure that the updated production procedures, schedules, and requirements agree with the proposed product baseline and the support plan. This coordination will reduce later changes. Inputs to the proposed product baseline include well-defined quality, time and cost goals, production drawings and specifications for the equipment and facilities required for initial test units, manufacturing processes and schedules, inspection and test plans and procedures, industrial support procedures, personnel and training requirements for follow-on production needs, and the funding and control data criteria for subsequent fiscal funding allocations and data feed-back requirements.

PM-15B ESTABLISH PRODUCTION CONTRACT DEFINITION PLAN

Concurrently with the updating of production requirements for the test unit and when required to meet follow-on production needs, a contract definition plan is established for follow-on

production. This plan will become the basis for mass production of operational units. It should include criteria for contractor bid proposals for the follow-on units. Its planning requirements should be similar to those previously described in PM-9. Schedule-balance requirements for the follow-on units should be included. It also should delineate the requirements for government-furnished versus contractor production equipment and facilities, detailed procurement specifications to which the prime contractors and subcontractors must abide, make/buy criteria, detailed cost criteria for estimates required to support further budget and fund allocations, critical material requirements, and a "change procedure" which provides for rapid management review and decision on any production changes.

SD-16 INITIATE PRODUCTION

Establishment of the proposed baseline configuration (SD-15) is followed by production of initial units for the first block of user service and operational suitability test items. Further production and subsequent concurrent support commitments are contingent upon formal acceptance of product baseline specifications (SD-17B). Support resources may or may not be acquired under the same production contract, depending on the procurement method selected, the nature of the system and equipment, and the contractor capability. One example might be consideration for multi-year procurement. Priorities may be established on line-of-balance type schedules to assure delivery consistent with operational objectives. Where appropriate, corollary procurement action should be taken to acquire additional installations and facilities.

SM-16 AWARD SUPPORT RESOURCES CONTRACT(S)

The logistic support section of the contract is based upon the quantity, schedule, and planned utilization of operational equipment. Common resources are normally procured through appropriate DoD commodity inventory managers. Logistics support management must define their procurement requirements for common material and related technical data in time to support test and operations. Contractual exhibits and work statements reflecting test, activation, and operational support requirements are negotiated.

PM-16A INITIATE PRODUCTION OF TEST UNITS

The procurement specifications for initial hardware units are released. Materials are allocated and the first test unit is fabricated. Provisions are made to assist in first article inspection. Production inspection and test of the initial hardware components is accomplished in support of engineering demonstrations. Facilities used in initial production are evaluated for change prior to further production. Supplemental training should be accomplished to take care of initial production personnel needs.

PM-16B REQUEST BID PROPOSALS FOR FOLLOW-ON UNITS

Production follow-on contract bid requests should be issued to the competing contractors. Proposal evaluation criteria, similar to those described in PM-7B, should be established.

SD-17A COMPLETE DETAILED PRODUCTION SPECIFICATIONS

The contract end item specifications are completed. These

are the "build-to"² specifications and production engineering drawings and documentation upon which acceptance and testing of the first production article and follow-on production can be based.

SD-17B CONDUCT FIRST ARTICLE INSPECTION

First article inspection consists of a review of drawings and specifications against the first article of hardware. Acceptance of this product baseline configuration establishes a "Key Approval Point" upon which follow-on production is contingent. The review includes system design, logistics, and production staff participation from the appropriate Service or OSD decision level. The review should insure that producibility in design has been achieved without compromising system concepts, maintenance supportability specifications, performance, and costs. Changes beyond this point usually result in block modifications which are generally very costly in comparison to prior specification and prototype changes. Any changes as a result of the inspection must be made in conformance with current configuration management directives and instructions. Inspection approval denotes formal acceptance of the detailed specifications as audited and approved contractual documents.

²"Build-to" specifications and drawings are the documents which describe in detailed technical terms the form, fit, and functional requirements that the system/equipment was built to meet. These requirements are very wide and complete in scope. They include such considerations as mechanical and electrical characteristics, reliability, maintainability, materiel, processes, human engineering, packaging and marking, corrosion control, safety, interchangeability, etc.

SM-17A COMPLETE SUPPORT REQUIREMENTS SPECIFICATION

Completion of support requirements specifications requires action similar to SD-17A for support equipment and facilities. Support management should assure appropriate inclusion of logistics support test requirements in production specifications. Each specification requirement should be reviewed to assure that technical data, personnel and training, and supply support interfaces are compatible with applicable configuration management directives and instructions.

SM-17B CONDUCT PRELIMINARY SUPPORT EVALUATION

A preliminary support evaluation of the production units should be accomplished during the first article inspection (SD-17B). It is important that support features which contribute to equipment readiness have been incorporated in the hardware in accordance with specifications. Results of this evaluation are reviewed as part of the "Key Approval Action" specified in SD-17B.

PM-17A TEST FIRST UNITS TO PRODUCTION SPECIFICATIONS

Production support for first article inspection and test will be provided during demonstrations that confirm the equipment meets "build-to" specifications. Review and acceptance of this test establishes the product baseline configuration upon which "Key Approval Action" for follow-on production is contingent. This review and approval is conducted by production management in coordination with system design and support management at the appropriate service or OSD decision level. This test must confirm that producibility in design has been achieved without compromising system performance and equipment readiness. Corrective action is taken where necessary. Production management is

responsible for the release and manufacture of follow-on items in accord with the audited and approved specification documents.

PM-17B EVALUATE PROPOSALS AND INITIATE FOLLOW-ON PRODUCTION

Concurrent with the acceptance of the first test articles, proposals submitted by the various contractors for follow-on production are evaluated. A selection is made. In cases where production quantities are very large, several contractors may be selected. This may be done for normal operational requirements or for future contingency planning. For major production runs, product baseline approval establishes the configuration which is the basis for further funds release.

SD-18 CONDUCT USER SERVICE TESTS

Service tests usually occur at a user test facility in a simulated environment. Resulting system, equipment, and support changes are reviewed by the user and developer and incorporated into follow-on production planning by engineering change proposals. Test results include limited performance experience, technical data validation, support and test equipment performance experience, equipment operator evaluation, and servicing and maintenance experience. Requirements for significant changes may result in the immediate initiation of a modification cycle as described in blocks SD-23 through SD-25.

SM-18 COMPLETE DEMONSTRATION AND EVALUATION OF SUPPORT REQUIREMENTS

Demonstration and evaluation of initial support resources and procedures are accomplished concurrently with the user service tests and equipment acceptance (SD-18 and 19). These tests should demonstrate achievement of all operational support readiness

specifications. Support element functions that support resources are utilized as planned or justify any changes. Management evaluations and failure analyses are accomplished where support element functions and hardware performance fail to meet specifications and goals. Required changes are processed in accord with applicable configuration management directives and instructions.

PM-18A DELIVER SERVICE TEST UNITS

The hardware and supporting requirements are delivered to a selected test facility for impending user service tests. Close coordination between the development commands, contractors, and the user is mandatory. Acceptance tests are conducted as appropriate. Deficiencies in delivery and acceptance actions are noted and fed back to production planning for corrective action.

PM-18B PROVIDE DEMONSTRATIONS SUPPORT

Previous production planning and contractual arrangements should have included the requirements for production support to demonstrate the first units at the user service test facility. This planning should call for the proper mix of contractor and government support. It should define all responsibilities for accomplishing the test. Production support for this demonstration should be based upon the requirements of the established operational and logistics support demonstration plan.

SD-19 ACCEPT SYSTEM FOR OPERATIONAL TESTING

Satisfactory completion of the service tests provides program management with the confidence necessary to continue production and acceptance of hardware in those quantities required for initial deployment to operational units. Further tests establish the degree of achievement of operational readiness performance specifications required by the contract (SD-22).

PM-19A UPDATE PRODUCTION REQUIREMENTS

Production requirements are updated by all elements based upon the results of the user service test evaluations. The production management plan for follow-on units is updated to reflect any changes in responsibilities, policies, controls, coordination, communications, and schedules. The updated plan is used for hardware production activities needed to equip and support follow-on operating units.

PM-19B INITIATE CHANGES TO PRODUCTION UNITS

As a result of changes made in production requirements (PM-19A), equipment in production should be evaluated. Those changes which will have a favorable impact on the requirements of initial operating organizations should be incorporated.

SD-20 VERIFY AVAILABILITY OF ALL REQUIRED SUPPORT RESOURCES

Prior to equipping the first operational organization, availability of all system and support resources to planned schedules should be verified. System/support commands, contractors, and using commands review and evaluate shortages, schedule balance, priorities, delivery plans, inventory distribution, and other applicable materiel management considerations. Coordination between the operational and system/support commands is necessary to apply corrective action and assure complete planning for operations and support. Time-phased activity schedules include the exact need dates and phase-over actions required to furnish equipment, tools and test equipment, spares and repair parts, technical data, trained personnel, training equipment, and other system and support resources to the operating units.

PM-20 COORDINATE DELIVERY OF ALL RESOURCES

Production support of the first operating unit requires the coordinated delivery of all system and logistics support resources according to planned schedules. Production management should review and evaluate shortages, schedule balance, priorities, delivery plans, inventory distribution, and other applicable management considerations for corrective action. Production schedules should include the exact need dates and phase-over actions required to furnish equipment, parts, data, personnel, and other resources necessary for the operating units support. These actions and need dates, included in previously negotiated contracts, should be in schedule balance with all plans and funding allocations.

SD-21 EQUIP FIRST OPERATIONAL ORGANIZATION (TEST)

Equipping the first organization can vary from the complex installation and checkout of a missile system to the delivery of a test unit. Similarly, the system activation and support effort covers a broad spectrum. Contract end items of equipment are shipped to the location of the designated test organization. Appropriate phase-over actions are carried out by both development and operational command personnel to assure the rapid and complete accomplishment of this task in accord with preplanned schedules. Installation and checkout includes receipt and acceptance of equipment and support resources, assembly, installation, test, integrated system checkout, and verification of the system and support resource performance as installed. Compatibility of all interfaces is verified.

SM-21 UPDATE LOGISTICS SUPPORT PLAN

Subsequent to user tests and during equipping of the first operational organization, the logistics support plan is updated

to reflect operational support changes to responsibilities, policies, controls, coordination, communications, schedules, etc. The updated plan is used for equipping and supporting operational organizations. The plan is the basis for staff actions in all required support areas at successively higher levels of management within the DoD.

PM-21A INSTALL EQUIPMENT AND CONDUCT ACCEPTANCE TESTS

Production support is provided to accomplish the actions described in SD-21. The exact mix of contractor vs. government support should be stipulated as requirements in the previously prepared production plans and negotiated production contracts. Phase-over actions by development and follow-on systems support command management personnel assure the rapid and complete accomplishment of this task in accord with schedule agreements. Appropriate acceptance records should be completed. Planning deficiencies should be recorded for feed-back through the control data system to future planning of follow-on units and similar systems.

PM-21B CHANGE HARDWARE AND PLANS

Changes to the hardware and production plans should be made. These changes should be based upon system/support/production evaluations of the deficiencies found during the installation and acceptance tests. The impact upon the production elements requirements should be analyzed and appropriate action taken to time-phase those changes into the plans and hardware.

SD-22 CONDUCT OPERATIONAL SUITABLE DEMONSTRATION

A predefined demonstration of a full complement of equipment is conducted by a typical user organization such as a ship, squadron, company, or regiment during routine training operations for a specified time period.

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The demonstration objective is to verify achievement of operational requirements (including readiness performance) through mission accomplishment in a defined environment with measured manpower skills and established equipment and facilities support. (See SD-9A through SD-10A on contract specifications development.

The value of the demonstration will be in direct ratio to the realism of the test ground rules and environment. Considerations should include personnel selection based on available skills and average manning levels, spare parts provisioning, test mission profile mix, special test data requirements, special test equipment, facilities, transportation, weather, etc. Management evaluation and control of such an operational test should be directed toward containing the test within these established rules and objectives. Care should be taken to avoid interference with the detailed operations and maintenance management of the test organization that would inject unrealism in the test situation.

PM-22 PROVIDE DEMONSTRATION RESOURCES

Production resources required to support the operational suitability demonstration should be based upon the requirements previously defined in the system operating, support, and production plans. The requirements should define production support within the ground rules described in SD-22. The government and contractor actions should be structured to avoid interference with the detailed operations and maintenance management of the test unit. Appropriate control of production records should be maintained such that data feed-back through the control data activity (CD-16 to 24) assures adequate information for follow-on production evaluation and future equipment production planning.

SD-23 IDENTIFY DEFICIENCIES

A typical change or modification cycle may be initiated by any one of several operational situations such as (1) the inability of the system or equipment to satisfy its current requirements, (2) changes to mission operational and support roles, (3) correction of discrepancies where the forecast operational and support goals were unrealistic or inaccurate, or (4) equipment failures caused by improper design or fabrication. In all cases deficiencies are identified and evaluated. Operational and value engineering trade-off studies are performed to determine the effect of these deficiencies upon future operations and support. A decision is made with regard to further program action.

SM-23 EVALUATE SUPPORT CAPABILITIES

As part of the operational suitability demonstration (SD-22) and concurrently with the identification of deficiencies (SD-23), the planned logistics support capabilities are evaluated to determine how well they satisfy support goals including readiness performance specifications. Support management reviews all element interfaces to see that control, communications, coordination and data reporting systems do not impede attainment of the logistics support requirements for readiness and cost. Detailed evaluations include verification of personnel skill levels, training and training equipment, adequacy of technical data, availability of spares and repair parts, adequacy of facilities, capability of support equipment, adequacy of data collection and distribution plans, and assessment of the overall support system capability to meet its readiness requirements.

PM-23 EVALUATE IMPACT OF DEFICIENCIES ON PRODUCTION

Deficiencies in equipment operations and logistics support should be evaluated for their impact upon the planned production

resources. These deficiencies may result from the conditions described in SD-23 and SM-23. In all cases, production management must evaluate these deficiencies for the impact upon the production resources and element tasks. Trade-off studies should be made to determine the impact of these deficiencies upon future production planning. Study results should be included as information for program management decision.

SD-24A PROPOSE MODIFICATIONS

Based upon the identified system and support deficiencies (SD-23), alternate approaches for modifying the system and support resources and procedures are developed. These alternatives incorporate the best of the field experience recommendations as well as innovations created by advances in technology. Emphasis is placed upon the correction of the deficiencies by procedural or simple workaround changes that do not degrade readiness. For example, new methods of field repair for electronic cards using available tools and test equipment may be better than the risk and effort involved in a functional design change to the electronic system. The best approaches are proposed in the modification package along with schedules, manpower, and cost estimates. The proposal should comply with the requirements of applicable configuration management directives and instructions.

SD-24B DECISION TO MODIFY

Configuration control action approving the modification package should be in accord with procedures implementing current configuration management directives and instructions. These procedures, directives, and instructions also establish levels of approval authority. Review and approval action at the appropriate decision level should include logistics and production staff

participation to insure adequacy of planning for further production and the logistic support of operational maintenance activities.

SD-24C INITIATE ACTION TO CHANGE PRODUCTION

Where major system or equipment changes are required, a new production cycle (beginning with SD-16) for follow-on operational units is initiated against the new configuration baseline. In such cases, modification studies involve planning sequences and actions which are equivalent to the definition and development phase tasks leading to a normal product baseline. The detail for each required action in this testing and analysis sequence may be reduced as appropriate to the modification requirements.

SM-24 EVALUATE SUPPORT IMPACT OF PROPOSED MODIFICATION

Support management insures that the impact of any proposed changes on the logistics support plan is evaluated by each logistics support element. The combined results of these evaluations are weighed. If changes are required, all changes to logistics support requirements are included in the proposed modification package.

PM-24A EVALUATE MODIFICATION IMPACT ON PRODUCTION

Based upon the decision to modify the equipment (SD-24B), production management should evaluate the impact upon future production planning. Changes to production plans and resources should be made in accord with the conditions described in SD-24A, B, and C.

PM-24B CHANGE PRODUCTION REQUIREMENTS AND INITIATE REPROCUREMENT

As a result of the modification decision, production management should assure that detailed specification changes are made

for special and common equipment and tools, facilities, material and such production plans and controls necessary to either effect a production recycle or support a modification program under field conditions. Reprocurement action should be initiated for any resources required. Schedule balance for operational and support requirements must be maintained.

SD-25 MODIFY EXISTING SYSTEM/EQUIPMENT

To assure mission success within the time constraints imposed by operational requirements and to satisfy safety, performance, economic, or other factors, it is often necessary to retrofit existing equipment. In this case technical compliance change packages are prepared which specify the change requirements, responsibilities, schedules, and funding by which the military organizations or selected contractors are to perform the required modifications. These changes are accomplished at field, depot, and contractor facilities as designated by the appropriate system/support authority.

PM-25A PROVIDE MODIFICATIONS SUPPORT

Previously negotiated plans should include the policies and responsibilities for providing modification support through either government or contractor means. This modification support should be scheduled in a manner to maintain optimum balance between operation of the system production schedules. It is based on the modification priority necessary to achieve both operation and logistics support objectives. Consideration is given to the planned availability of resources and personnel.

PM-25B PROVIDE UPDATED REQUIREMENT, AND SUPPORT

The production resources to be used for equipping the follow-on operating units should be refined. This information is used by the systems support commands to provide updated planning for further procurements, repair, and modifications. It is also useful as experience information for project managers engaged in the planning of new systems and equipment. These updated requirements should include production schedule balance for the remainder of the program. They should consider reallocation or disposition of production resources based upon changes to the required operational capability, equipment obsolescence, operations and maintenance cost, and new equipment which is entering the inventory. Alternative production plans are prepared and/or updated for a production preparedness program covering expected contingency conditions which are part of the most recent force structure forecast.

SM-26 EQUIP FOLLOW-ON OPERATING UNITS

After satisfactory completion of operational suitability testing, follow-on operating units are equipped. Operational commands direct mission assignments of subordinate organizations and monitor their support performance. Local analysis of "failure data" (summarizing maintenance actions) along with performance data on mission accomplishment and support responsiveness, permits unit commanders to separate true hardware deficiencies from deficiencies in manning, maintenance procedures, supply response, organizational management, etc. This evaluated data should be summarized for transmittal to higher operational and functional commands. Corrective action beyond the capability of unit commanders becomes a requirement for higher command action.

Subsequent command analysis involves comparisons of the following type among the operating units: (1) mission performance, (2) maintenance effectiveness, (3) supply responsiveness, and (4) hardware failure trends. Unit performance of such parameters can be weighed against command averages and trends.

Concurrent with operational command management analyses, the system support command will receive raw hardware failure and support data for analysis by the project system support manager (and/or commodity manager). The results of these analyses are used to update support and production planning for further procurements, repair, and modification. They also provide experience information to project managers engaged in the planning of new systems and equipment.

Reallocation or disposal of operational, support, and production resources is based upon consideration of changes to the required operational capability, technological obsolescence, operations and maintenance costs, and the acquisition of new equipment into the inventory. Integrated logistics support and production planning for future equipment development and acquisition should include data from operations and support experience as an aid to management.

P R O D U C I B I L I T Y

Interface Responsibilities:

- Plans and Controls Criteria for Configuration, Quality, Cost, and Schedule Balance
- Manufacturing Characteristics for Systems and Logistics Support Resources
- Inspection and Test Specifications
- Equipment and Tools Design Characteristics
- Production Facilities Design Characteristics
- Industrial Support Goals and Requirements
- Personnel Skills Requirements and Training Criteria
- Funding Requirements, Allocation, and Production Cost Criteria
- Control Data for Use in Design/Support/Producibility Trade-offs

3. PRODUCIBILITY

3.1 INTRODUCTION

Producibility is the composite of characteristics which, when applied to equipment design and production planning, leads to the most effective and economic means of fabrication, assembly, inspection, test, installation, checkout, and acceptance of systems and equipment. Producibility includes considerations of the materials, tools, test equipment, facilities, personnel, and procedures which support the production cycle. Early operational and economic trade-offs of the characteristics in equipment design, support, and production requirements provide increased production effectiveness at least total cost. Producibility requirements should be incorporated into equipment design and support system design specifications. They include such things as anticipated production rates, material limitations, standardization, manufacturing constraints and risk areas (e.g. fabrication limits on capabilities when forming, casting, forging, and machining), alternative schedules, numerically controlled tools, etc. "Producibility" should result in the optimum end result of production resources availability, equipment readiness, performance, and cost effectiveness.

Surveillance over changes to designs and logistics support requirements is required to prevent degradation of producibility. As equipment designs are released, demonstrations with the production resources must be conducted to see that the producibility requirements are met. The results are analyzed and trade-off studies are made to improve producibility of the system. Inclusion of producibility considerations in system trade-offs results in a

firm specification baseline prior to mass production. Maximum benefits are gained during early trade-offs. (See Figure 4.)

Figure 6 and the following paragraphs describe the relationships among system design, logistics support, producibility, and the other elements of production management.

3.2 DETAILED EVENT DESCRIPTION

P-2 PREPARE PRODUCIBILITY ESTIMATE

Based upon experience data (CD-2) from similar systems and equipment, producibility estimates are made for inclusion in PM-2. These estimates include consideration of common versus special materials, supply of critical items, high risk areas introduced by new manufacturing processes (e.g., automated control techniques such as numerically controlled tools), capability of government and industry production units, and recent techniques and constraints. Experience data from previous programs provide a summary estimate of the current capacity for producing equipment and should be considered in preparing the production capability input to the operational capability document (SD-2). This is essential to systems trade-offs so that the need for exploratory development can be separated from state-of-the-art conditions.

P-3 PERFORM PRODUCIBILITY TRADE-OFFS

Producibility considerations in system feasibility studies (SD-3) require that design/support/production trade-offs be conducted. The trade-offs determine the optimum balance among the operational, logistics support, and production requirements and capabilities prior to establishing producibility goals. These trade-offs should consider such things as:

- Alternative forming and assembly methods and capacities (e.g casting, forging, press forming, riveting, welding, etc.);
- Alternative machine capabilities (e.g. lathe turning, grinding, milling, cutting; and manual, automatic, numerically controlled, etc.);
- Single vs. multiple fabrication, assembly and test lines for optimum total production flow rates;
- Installation, inspection, test, quality, cost and schedule balance techniques and controls;
- Available vs. new production equipment, tools, and facilities;
- Critical material items status and forecast;
- Available vs. required personnel skills and quantities;
- Preliminary estimates for funds allocation and control; and
- Risks associated with production planning based on proposed and projected capabilities, especially where "state-of-the-art" advances are required.

Producibility trade-off decisions become a significant input to the production concept (PC-4).

P-5 ESTABLISH PRODUCIBILITY PLAN REQUIREMENTS

Selection of a total systems concept, including logistics support and production, is followed by development of specific producibility requirements for inclusion in the production plan requirements (PM-5). They include producibility goals (i.e. results of the considerations in P-3) for design definition,

requirements for the identification and tailoring of production specifications, and selection of methods to demonstrate achievement of producibility during subsequent phases. These requirements should be compatible with other production element inputs to PM-5. They should be specific enough to be included in contract definition work statements and specifications.

P-7 ESTABLISH PRODUCIBILITY EVALUATION CRITERIA

Criteria should be established to evaluate the contractors' ability to develop a producible system design. The criteria should include suitable methods for evaluating the adequacy of quantitative predictions and measurements for equipment, facilities, time, and cost as well as proposed plans for demonstrating the attainment of producibility during the early portion of production and test phases. Emphasis should be placed upon areas of high risk to total production which might jeopardize schedule balance, product quality, and total cost.

P-8 PERFORM EVALUATION OF PRODUCIBILITY PLAN PROPOSALS

The contractors' producibility program proposals are evaluated and scored. The proposal which best fulfills the criteria of P-7 is selected as a pattern for further contract definition. It becomes part of the production management evaluations (PM-8). The contractors' producibility plans should contain:

- Producibility characteristics and goals;
- Review demonstration and evaluation plans that will lead to product baseline specifications adequate for follow-on production runs (PM-17A);
- Producibility trade-off and quick change procedures; and

- Producibility guarantees and incentives applicable to the particular system and equipment contract.

P-9 ESTABLISH PRODUCIBILITY GUIDELINES FOR DESIGN

The characteristics, requirements, and goals are translated into explicit system and equipment design criteria, such as:

- Constraints on critical types, quantities, and use of materials;
- Forming, machining, and assembling constraints based on estimated production capability;
- Estimated lead times for high risk production parts by type and quantity; and
- Common item procurement limits and change conditions relating to replacement of old with new production items.

P-10 UPDATE PRODUCIBILITY PLAN

During system and equipment design, the producibility plan is updated to provide more detailed criteria. This action results from the continuing analyses of production methods, drawings and specifications, production engineering, systems engineering, and support documentation. The objective is to identify all key producibility "design to" characteristics for hardware components to reduce production time and technical skills, establish optimum schedule balance for the production phase, improve producibility analysis techniques and inspection and test routines, minimize requirements for special tools and equipment, provide commonality between similar logistics support and production requirements, and provide control data feed-back to expedite design and production capability evaluations. Maximum emphasis should be given to the operational and value engineering trade-offs between reliability,

maintainability, and producibility during this design phase. These integrated trade-offs must be performed such that the resulting requirements impact on all elements can be evaluated and justified.

P-11 APPORTION DETAILED PRODUCIBILITY REQUIREMENTS

As system specifications, drawings, and other production engineering documentation are completed, producibility requirements are apportioned to the detailed design of equipment. Producibility constraints and limits for maintaining quality and reducing time and cost for total production are assigned. Trade-offs, performed as necessary, include analyses of types of material, fabrication techniques, and assembly methods. The effect of changes on equipment design and logistics support as well as production should be considered. Producibility functions should assure that operational and support effectiveness is maintained.

P-12 EVALUATE PRODUCIBILITY OF INITIAL TEST HARDWARE

During production of prototypes and hardware needed for subsystem and system testing, acceptance evaluations are conducted. The evaluations must include examination of all production methods and equipment for compliance with the producibility requirements previously incorporated into the specifications and plans. Deficiencies must be evaluated for their impact on system design, support and production plans. Corrective action is made by controlled changes to the drawings or production plans. These changes must be in accord with configuration management directives and instructions.

P-13 and -14 EVALUATE PRODUCIBILITY IN TEST CHANGES

Design/support changes made as a result of the subsystem and

system demonstrations must be evaluated for their impact upon producibility. Evaluation results should be coordinated with system design and logistics support so that all pertinent considerations are included in trade-off studies. Approved changes are incorporated into the drawings and specifications. End item production drawings, specifications, and other data are changed as necessary. Data resulting from these evaluations should be made available for future planning of other production programs.

P-15 UPDATE PRODUCIBILITY PLAN

The producibility plan, including design guidelines for further production hardware, is updated to incorporate all approved changes. The plan becomes part of the proposed product baseline (SD-15). It also may be part of the contract definition plan for production depending on the equipment, type of contracts, and rates of flow expected for follow-on production (PM-15B).

P-16 DEFINE PRODUCIBILITY CRITERIA IN PROPOSALS

Depending on contractual arrangements and timing, producibility plan requirements are included in the request for proposals for follow-on production. The requirements (similar to those described in P-5) should include well-defined specifications updated by the results of previous testing of the initial production units. They should specify needs and constraints relating to schedule and cost. Balanced output of future production units and allowance for contingency planning for future emergency conditions should be the objective. For example, low to high flow production may require alternative considerations for machining, forming, assembling, and numerical programming.

P-17 EVALUATE FIRST UNITS PRODUCIBILITY TO THE PROPOSED PLAN

First article inspection actions should place emphasis on reviewing producibility deficiencies noted in previous tests and system and subsystem demonstrations. This will assure that previous deficiencies have been corrected without imposing new problems. Producibility requirements should be reviewed against hardware to be certain that engineering changes up to this point have not degraded producibility nor introduced problems which may affect operations and support.

When required, and concurrently with the evaluation of the first article, contractor producibility plans for follow-on production will be reviewed and evaluated. The best proposal is selected. The selected producibility plan becomes part of the product baseline for follow-on production (SD-17B and PM-17B).

P-18 EVALUATE SERVICE TEST CHANGES

Conduct of the user service test (SD-18) may result in changes to the operational and logistics support plans. These changes should be evaluated for their impact on producibility. Final configurations should be based upon combined design, supportability, and producibility trade-offs.

P-19 UPDATE PRODUCIBILITY PLANS

The updated producibility plans become the basis for evaluating and verifying achievement of producibility during the assembly, installation, acceptance tests and final checkout of equipment for the first operating unit (SD-21).

P-21 VALIDATE PRODUCIBILITY CRITERIA

During acceptance testing, installation, and checkout of equipment for the first operating unit, producibility specification

requirements are evaluated against the equipment and procedures. Changes are made to the production hardware and plans accordingly. Evaluation results should be reported through the control data system to assure that future planners will have visibility of problems encountered.

P-24 EVALUATE OPERATIONAL TEST RESULTS

System and equipment changes resulting from the operational suitability demonstrations are evaluated for their impact upon producibility. Producibility changes should be rapidly reviewed and incorporated into production (PM-24A and B) to maintain configuration and quality control.

P-25 ESTABLISH PRODUCIBILITY PLAN

Based upon the results of completed tests and the modification reviews and decisions, the producibility plan is updated for use in future production. It is used by the system support and commodity command functions for follow-on procurements of hardware and other resources.

CHAPTER 4

I N T E R F A C E R E S P O N S I B I L I T I E S

Interface Responsibilities:

- o Producibility Specifications and Guidelines
- o Manufacturing Processes Experience on Fabrication, Assembly, Installation, Test, and Checkout
- o Inspection and Test Concepts and Requirements
- o Equipment and Tools Requirements, Specifications, Drawings, and Availability
- o Facilities Requirements, Specifications, and Use Experience
- o Industrial Support Plans for Critical Materials, Equipment and Facility Distribution, and Government/Contractor Relationships
- o Personnel and Training Requirements, Availability, and Distribution
- o Funding Requirements and Allocations
- o Control Data Needs for Engineering Analyses, Product Improvement, and Management

4. PLANS AND CONTROLS

4.1 INTRODUCTION

The plans and controls element defines requirements for production procedures and controls for maintaining configuration, quality assurance, schedule balance, and cost effectiveness throughout the production cycle. It provides direction, regulation, and coordination necessary to meet producibility goals and requirements. To satisfy operational and logistics support requirements, production plans and controls events must include the functions necessary to support development, fabrication, assembly, installation, acceptance, test, and checkout of the prime system and equipment. It also must plan for and control the actions, techniques, and resources needed to perform those functions. Engineering analysis is accomplished to assure that all requirements are defined for those actions and resources which must produce the major systems and equipment. Quality, configuration, current and future cost-in-production and controls are developed to assure production of the system or equipment to the established reliability, maintainability, and producibility requirements. Although sub-elements of plans and controls may be separately organized, their events and interfaces are described here in a manner which will provide an integrated plans and controls approach for the complete production management cycle.

During concept formulation and contract definition, production plans and controls assess the current production capabilities against the evolving system. The assessment is the basis for the development of alternative production concepts and requirements which are further considered in the system and support feasibility

trade-off studies. As development progresses, these concepts and requirements become definitive specifications to be met by production procedures and resources. Detailed production engineering analysis must be accomplished concurrently with hardware and support system design and updated as the system design evolves. The engineering analysis documentation provides identification and description of the fabrication, assembly, installation, test, checkout and acceptance tasks, and the equipment, tools, facilities, personnel, and procedures necessary to accomplish those tasks. It includes quantification of the above items by time and place, personnel skills, types of facilities and use, and critical material requirements. These analyses are included in the control data system for use by all elements in their further planning efforts. Plans and controls are selectively tailored to the complexity of the hardware and the production program detail required. In addition to establishing the requirements and procedures for accomplishing all production actions, controls must be selectively defined which will assure that configuration, quality, schedule balance, and cost-effectiveness are maintained to meet program objectives throughout contract definition, development, and production. As used in this guide, the controls include such things as:

- The procedures, processes, evaluations, coordination, records, reports, reviews, and approvals necessary to identify, maintain status accounting of, and manage the configuration of the item being produced and the associated actions and resources essential to its production. Planning for and changes to the production configuration must be in conformance with applicable configuration management and work breakdown structure directives and instructions.

- The procedures, processes, evaluations, coordination, records, reports, reviews, and approvals necessary to diagnose, sample, measure, gauge, analyze, etc. the configured item being produced and the associated actions and resources essential to its production to assure quality of delivered product. Planning for and accomplishment of quality assurance must be in conformance with applicable directives and instructions.
- The procedures, processes, evaluations, coordination, records, reports, reviews, and approvals necessary to provide schedule balance among all production element actions and their interfaces essential to the planning, producing, delivery, and subsequent production support of the configured item. Selected schedule balance controls must be in conformance with applicable DoD program/project management control directives and instructions.
- The procedures, processes, evaluations, coordination, records, reports, reviews and approvals necessary to provide cost control (e.g. in procurement specifications, budgeting and accounting procedures, work-loading processes, production milestone checkpoints, fiscal funding breakdown, etc.) among all production elements and their interfaces throughout their planning, physical production, and subsequent production support actions.

Plans and controls events, policies, and responsibilities are dependent on the complexity of the program, degree of government/contractor involvement and the type of procurement. Figure 6 and the following paragraph descriptions cover typical relationships between the plans and controls element and other elements of production management.

4.2 DETAILED EVENT DESCRIPTION

PC-2 PROVIDE PLANS AND CONTROLS ESTIMATES

Plans and controls concepts used during the production of similar systems and equipment are provided. Requirements estimates for alternative producibility concepts are developed. The concepts and requirements estimates are included in the production capability estimate (PM-2). The plans and controls estimate should include current information on product configuration, quality, cost, and schedule balance techniques, high-risk requirements experience from previous programs, summary information on equipment, tools, facilities and personnel, and experience on previous problems and deficiencies.

PC-3 EVALUATE SYSTEM AND SUPPORT ALTERNATIVES

Concurrent with the development of producibility alternatives, plans and controls concepts are defined and analyzed. Preliminary production engineering analyses are conducted to determine gross requirements for each of the alternatives. These requirements are used to support the producibility and cost trade-offs in the system feasibility studies (P-3 and SD-3). The plans and controls evaluation should include:

- Qualitative and quantitative estimates of the personnel, facilities, equipment, and tools requirements;
- Cost estimates for definition and development phase production support and the initial and follow-on production requirements based on estimated quantities of produced units;
- Plans and controls techniques required for each alternative; and

- A comparison of the identifiable high-risk areas for each alternative.

PC-4 ESTABLISH PRELIMINARY PRODUCTION CONCEPT

A preliminary production concept is documented to provide guidance to the other production elements and for the definition of further requirements. Depending on the depth of definition required, the production concept should include:

- The estimated production locations;
- Gross schedules for fabrication, assembly, test, installation, checkout, and anticipated modification;
- Criteria for government vs. contractor support;
- Preliminary inspection and test concepts;
- Types, quantities, locations, and use of equipment, tools, and facilities;
- Materiel procurement concepts and critical item control and use;
- Personnel and training concepts, including manpower curves; and
- Preliminary cost estimates and control data requirements of all elements.

The concept document should be submitted in summary form for inclusion in the production program change request (PM-4).

PC-5 ESTABLISH PLANS AND CONTROLS REQUIREMENTS

Production plans and controls requirements are developed for inclusion in PM-5. These requirements are the basis for contract developed plans and controls during contract definition. They

must identify project and contractor responsibilities for further production planning events. The requirements may call for or include, as a minimum:

- Definition of the contractors' production processes;
- Planning milestones and their interface with the hardware design and logistics support schedules;
- The criteria and techniques to be used for configuration, quality, cost and schedule control, and their demonstrations.
- The selective plans and controls management and analytical techniques to be used;
- The criteria and limitations for definition of government-furnished production equipment and facilities; and
- The specifications for engineering analysis documentation and other detailed and summary data which may be required.

PC-7 ESTABLISH PLANNING AND CONTROL EVALUATION CRITERIA

Contractor-proposed plans and controls should be evaluated for their responsiveness to the requirements (PC-5). The evaluation criteria should include means for:

- Comparison of the relative production costs in terms of man-hours and investments in special equipment and facilities;
- Comparing the impact of risk area modifications or changes; and
- Evaluating the production performance/cost impact of trade-off rationale relating schedule against current production rates.

PC-8 EVALUATE PLANS AND CONTROLS PROPOSALS

The plans and controls proposals should be evaluated to the criteria established in PC-7. The results are included in the production management evaluations (PM-8).

PC-9 APPROVE PRELIMINARY PLANS AND CONTROLS

Updated production plans and controls are approved for use by all elements during development and production.

PC-10 CONDUCT PRODUCTION ENGINEERING ANALYSES AND MONITOR PROTOTYPE PRODUCTION

System and equipment specifications and drawings and program plans are the basis for a production engineering analysis to determine the required manufacturing actions and resources considering frequency, time, and location. The analysis is interfaced with the system design and support analyses through documentation which identifies and controls changes among design, support, and production requirements. Production engineering analysis identifies the requirements for manufacturing personnel skills, equipment and tools, facilities, material item requirements, specific manufacturing processes, and schedule balance for integrated production of the hardware items. The analysis begins on a preliminary basis during early development and is continually refined to form the production planning contribution to the proposed product baseline (SD-15). Although the detailed analysis is used as a working tool within government and industry production organizations, summary analyses are provided for visibility to program, design, and support management throughout procurement, testing, and follow-on production.

2

PC-12 UPDATE PLANS AND CONTROLS

Production engineering documentation is provided to integrate the requirements, policies, procedures, and responsibilities for initial and follow-on production. This documentation will provide the basis for the control of revisions to configuration, quality, cost, and schedule balance during subsequent planning and manufacturing effort.

PC-13 and -14 EVALUATE DESIGN/SUPPORT CHANGE IMPACT

Changes resulting from subsystem and system demonstrations, and logistics support evaluations should be reviewed for their impact on production. Further requirements for initial and follow-on production should be defined. Requirements for resources common to logistics support and production should be integrated. Special attention should be given to long lead procurement items, high cost items, or high risk items that may impact follow-on production.

PC-15A UPDATE PLANS AND CONTROLS (TESTS)

Changes resulting from the test evaluations should be incorporated in the proposed product baseline plans and controls (PM-15A).

PC-15B ESTABLISH FOLLOW-ON PRODUCTION REQUIREMENTS

The updated plans and controls for test units form the basis for requirements for the follow-on production plan. These requirements should be similar to those described in PC-5. They are expanded to include follow-on considerations such as the make/buy criteria, government/contractor relationships for expanded facilities and equipment, and the procedures, responsibilities, and limitations for configuration, quality, cost, and schedule

control through all levels of production. They should include requirements for information necessary for production management decisions on block changes to the follow-on units. These requirements should be included in the request for proposals for systems and equipment requiring additional procurement action at this point.

PC-17A EVALUATE FIRST ARTICLE CHANGE IMPACT

Tests of the first hardware units to their "build-to" specifications should be reviewed. The updated plans and controls are included in the product baseline configuration (PM-17B) for further production.

PC-17B EVALUATE AND APPROVE PLANS AND CONTROLS

Proposals submitted by the various contractors for follow-on production are evaluated and scored. The proposal selected for the production of operational units becomes an integral part of the production baseline (PM-17B) approval for further funds release.

PC-18 EVALUATE PLANS AND CONTROLS DURING ACCEPTANCE TEST

Discrepancies found during the acceptance of the systems and equipment for user service tests should be evaluated. Changes to plans and controls, made as a result of any discrepancies, should be based upon goals and limits established during contract negotiations for production.

PC-20 EVALUATE PLANS AND CONTROLS -- FIRST UNIT DELIVERY

System/support commands, contractors, and using commands review and evaluate the shortages, schedule problems, priorities, delivery plans, inventory distribution, and any other applicable

management considerations for possible corrective action. Concurrent review of the production plans and controls is required to assure that their time-phased activity schedules include the exact need dates and phaseover actions to meet the availability requirements for all system and support resources.

PC-21A EVALUATE PLANS AND CONTROLS -- INSTALLATION AND CHECKOUT

The production schedules, procedures, interfaces, coordination actions, and configuration efforts which support installation and checkout are reviewed and evaluated for any necessary changes.

PC-21B UPDATE PLANS AND CONTROLS

Plans and controls are revised to incorporate all of the changes required for equipping follow-on operating units.

PC-23 EVALUATE DEFICIENCY IMPACT ON PLANS AND CONTROLS

System and support changes resulting from the operational suitability demonstration are reviewed. All deficiencies should be evaluated for their impact on production plans and controls.

PC-24A PROVIDE PLANS AND CONTROLS FOR MODIFICATION EFFORT

Supplementary plans and controls are prepared for changes to production resources for field modifications. These supplementary plans and controls should be included in the production management evaluations (PM-24A). They may be the basis for requirements initiating additional procurement for modification efforts.

PC-24B UPDATE PLANS AND CONTROLS (FOLLOW ON UNITS)

Plans and controls resulting from all changes are incorporated into the modification requirements package.

PC-25A EVALUATE IMPACT OF MODIFICATIONS

Plans and controls should be reviewed and evaluated during actual modifications.

PC-25P PROVIDE UPDATED PLANS AND CONTROLS (FUTURE PLANNING)

Plans and controls are updated to include all supplemental information resulting from equipping the first organization and conducting operational suitability demonstrations. They should be provided as part of the overall production requirements package (PM-25) for use during subsequent organic or contractor support efforts. The information also should be furnished for future planning (CD-18B to 26).

CHAPTER 5

M A N U F A C T U R I N G

Interface Responsibilities:

- o Producibility Characteristics and Requirements
- o Plans and Controls for Fabrication, Assembly, Test, Delivery, Installation, and Checkout
- o Inspection and Test Procedures and Policies
- o Equipment and Tools for All Manufacturing Processes
- o Facilities Plans, Arrangements, and Use
- o Industrial Support Materials, Responsibilities, and Interface
- o Personnel and Training Availability and Use Plans
- o Funding Requirements, Allocation, and Cost Criteria
- o Control Data for Management and Future Planning

5. MANUFACTURING

5.1 INTRODUCTION

The manufacturing element should include all of the planning events necessary to assure the economical fabrication, assembly, test, delivery, installation, checkout, acceptance, and physical demonstration of the equipment and systems to their specified operational and support goals and requirements. These activities may be accomplished in support of engineering test models, mockup units, prototype hardware, field test hardware, and equipment delivered to the operating units. They may be in support of military field and depot or industry supporting activities.

For better understanding, the following descriptions are in order:

- Fabrication includes the actions essential to creation of a part by forming, cutting, lathe turning, milling, drilling, and welding of raw materials;
- Assembly includes all steps necessary to fit the fabricated parts into equipment, subsystem or system units;
- Delivery encompasses all actions necessary to assure the transfer of materials, parts, assemblies, etc., from their point of origin to the point of use;
- Installation includes all actions necessary to position, hook up, and/or make ready the weapon systems and equipment for service or use;
- Checkout includes those actions necessary to verify that systems and equipment interface properly to each

other and to the facilities, and operate within the limits specified by their specifications, drawings, and procedures;

- Acceptance encompasses the monitoring and approval actions necessary to provide formal written agreement between parties that the system, equipment, and support resources have met a specific portion of a contract, or the total contract; and
- Physical demonstration involves the operation and physical tests to prove that the weapon systems, equipment and support resources will perform, within prescribed environmental limitations, to established goals. Such demonstrations may be used to establish technical and management procedures.

As applied to the manufacturing element, the descriptions in this section are limited to providing technician support for all manufacturing events necessary to meet program acceptance milestones.

The manufacturing program primarily supports the production phase of an equipment program. However, it may be called on to support concept formulation, contract definition, and both early and late operation phases. The manufacturing planning events and their sequential relationship to other production element events and to production management are shown in Figure 6.

5.2 DETAILED EVENT DESCRIPTION

M-3 FABRICATE SYSTEM AND EQUIPMENT MODELS

Development of feasibility estimates described in SD-3, SM-3, and PM-3 requires that different manufacturing techniques

be explored. The various techniques are developed to the extent necessary to provide hardware which supports the systems and logistics engineering tests of models and equipment fabricated for the various study alternatives. They must include such things as techniques for processing new materials which may require different skills for welding, numerical programming of machine tools, and various forms of multiple machining tasks. The system and equipment models may be utilized through the contract definition phase to assist in requirements definition and to provide a means of testing selected alternatives without having to produce large mockups of actual hardware assemblies.

M-4 PROVIDE MODEL TEST SUPPORT

Alternative concepts using models developed in M-3 are tested to make the proper selection of a final concept for contract definition. Manufacturing technician support during this period should be provided to evaluate the skill and model requirements for system definition and development.

M-7A to -9A FABRICATE SYSTEM AND EQUIPMENT MOCKUP

During the definition phase, mockups are developed to provide a simulated form-fit-function display of the complete system and its equipment. Manufacturing support must be provided to fabricate equipment and assemble and install the mockup to accurately portray the requirements defined by initial specifications and preliminary sketches and drawings. Special technician support is provided for limited engineering test of those high risk equipments for which prototype hardware is built early in the program.

M-7B to -9B PROVIDE MOCKUP INSPECTION AND TEST SUPPORT

During proposal preparation, evaluation, and subsequent approval, manufacturing technicians perform tests which assure that producibility and quality criteria have been incorporated into the system and equipment drawings and specifications. Records and reports of these tests should be made available for proposal evaluation (SD-8). These records and reports also may be required for mockups being developed for government use. The information should be utilized for development of the production plan. Use of the mockups may continue into the development phase to allow system design and logistics support engineering personnel to evaluate required functions as they complete their detailed design and support requirements.

M-10 to -12A FABRICATE EQUIPMENT AND ASSEMBLE SYSTEM (PROTOTYPE)

As detailed analyses and design progress, equipment and sub-systems are fabricated for experimental test. The production run plans and controls designed to route materials, equipment, sub-assemblies and assemblies through the shops are verified against the experience gained in the manufacture of experimental test equipment. The plans and controls encompass different forms of machine groupings and shop mechanization. Initial numerical control programming of machine groups or individual machine setups may be tested in preparation for future high flow production. Tooling combinations should be tested to provide the best "mix" for programmed production units. Plant layout for equipment (machines, tools, jigs, fixtures, etc.) and personnel will be verified. Where test hardware may vary from that scheduled for production of initial units, these variations ordered, and separate engineering and manufacturing fabrication and assembly models of the production equipment should be tested prior to production of the first operational units.

M-11 to -12B PROVIDE EQUIPMENT AND ASSEMBLY TEST SUPPORT

Components, equipment, and subassemblies will be tested for their performance to specification. Technician support is provided to conduct engineering form, fit, and function tests of experimental hardware. Deficiencies are recorded in the manufacturing records. Appropriate action is taken through plans and controls to assure that all drawings, procurement specifications, and fabricated hardware are compatible.

M-13 and -14 PROVIDE SUBSYSTEM AND SYSTEM DEMONSTRATION SUPPORT

Technicians are provided to assist in engineering demonstration of the hardware. Logistics support requirements are tested to the degree practical on the prototype systems. Initial production planning procedures are followed explicitly. Production records must be kept on all deficiencies which occur during the subsystem and system demonstration. A technician to engineer interface is maintained throughout this demonstration to assure that design/support changes are correctly incorporated into the specifications and drawings. Appropriate action is taken to change and retest hardware to the revised specifications prior to establishing the proposed product baseline.

M-16 and -17 FABRICATE FIRST TEN UNITS AND PROVIDE FIRST ARTICLE ACCEPTANCE SUPPORT

Award of production contracts for initial hardware and support resources is followed by release of production orders for fabrication of the first test units. Programming of these test units through the fabrication cycle is accomplished to balanced schedules established in the plans and controls. Components, equipment, subassemblies and assemblies are produced and delivered per schedule by the government and prime, associate,

and subcontractors. These units are scheduled for first article inspection to evaluate their conformance with specifications. Technician support is provided for this inspection. Production records are maintained on all actions and deficiencies. Management records should note the adequacy of planned facilities and tooling to meet production specifications, schedule of produced items against their program milestones, mechanized control of discrepancies for fabrication (e.g. numerical programming, class-of-work, arrangement of machine tools, progressive manufacturing arrangement for materials and personnel), and manufacturing to engineering test interface problems during flow of manufactured units.

M-18A PERFORM ASSEMBLY AND CHECKOUT

Subsequent to first article acceptance, manufacturing support is provided to assemble, install, and check out the equipment in the operating and support configuration required for user service tests. Depending on the program, the assembly and check-out effort may be conducted at either a contractor facility or government facility. A combination of contractor and service personnel may be used. To the maximum degree practicable, the skills of the support technicians should agree with the skills specified for user operation and maintenance. Generally, a combined technician/engineer team is used for the demonstrations and evaluations. Combined contractor/user production and coordination records assure that deficiencies found during service tests are recorded and reported for appropriate design action and revision of the production specifications, plans, and controls.

M-18B PROVIDE PRODUCTION RUN FABRICATION AND SUPPORT

Upon award of follow on production contracts, manufacturing

organizations begin production of equipment on schedule released by production order. This action begins with a limited effort to equip the initial operating unit and gradually increases to the needed capacity for achieving planned production rates. The effort continues through the production and operational phases until all follow-on operating units have been equipped and modifications accomplished.

M-20 PROVIDE RESOURCES DELIVERY SUPPORT

Manufacturing support is provided to deliver resources in accordance with the schedule milestones previously established in the plans and controls. Appropriate phaseover actions between contractor and government units responsible for the delivery and acceptance of resources must be planned and accomplished. Organizational policies and procedures must include a complete manufacturing delivery and support interface. Records are maintained for all delivery actions. Deficiencies are fed back to plans and control units for corrective action.

M-21 PROVIDE ACCEPTANCE, ASSEMBLY, INSTALLATION, AND CHECKOUT SUPPORT

Manufacturing support similar to that described in M-18A is provided for acceptance, assembly, installation, and checkout support of the initial operational test units scheduled for suitability demonstration. For systems such as aircraft or ground transportation, there may only be a requirement for an acceptance function. Systems such as missiles, complexes, and other fixed installations require combined contractor, developer, and user support during the assembly and checkout. This support may continue through the operational suitability demonstration and beyond. In all cases, formal acceptance records should be established among the contractor, system support command, and the

using command prior to conduct of the controlled suitability demonstration.

M-22 PROVIDE DEMONSTRATION SUPPORT

Technician support is provided for the operational suitability demonstrations in accordance with negotiated contracts. Manufacturing support, if necessary, should not interfere with the normal operations and maintenance provided by the operating organization.

M-24 FABRICATE AND/OR RESTORE RESOURCES

Based upon the decision to modify the hardware (SD-24B), new plans and controls may require new production equipment or modification of existing equipment. Adjustments to the manufacturing facilities and tooling also may be required. Manufacturing planning must be accomplished in accord with previously described events.

M-25A PROVIDE MODIFICATION SUPPORT

These modifications requiring field support by the manufacturing organization must be in accord with supplemental plans and controls described in PC-24A.

M-25B PROVIDE SUPPORT (FOLLOW-ON OPERATING UNITS)

Manufacturing support is provided to equip all follow-on operating units. Field technician support may be required at each follow-on operating unit based upon phaseover requirements previously negotiated. Manufacturing support should be a result of trade-off studies conducted to achieve the most effective and economical delivery, assembly, installation, checkout and support program for organizational, intermediate, or depot units. The

support should include the "mix" most favorable to the operational readiness of equipment. It should be furnished in accordance with updated plans and controls used by the system operating and support command functions. It should be in consonance with the delivery requirements for the follow-on operating units. Planning must include safety and emergency requirements essential to overall production and support effectiveness.

CHAPTER 6

I N S P E C T I O N A N D T E S T

Interface Responsibilities:

- o Producibility Specifications and Guidelines
- o Plans and Controls for Conduct of Inspections and Tests
- o Manufacturing Actions and Processes for Achievement of Inspection and Test Procedures
- o Equipment and Tools Characteristics and Use Information
- o Facilities Requirements and Use
- o Industrial Support Techniques and Requirements
- o Personnel and Training Requirements and Limitations
- o Funding Requirements, Allocations, and Cost Criteria
- o Control Data Requirements for Performance Measurement of Production Actions and Processes

6. INSPECTION AND TEST

6.1 INTRODUCTION

The development of new equipment and the improvement of existing equipment requires ever increasing machine precision and test measurement in manufacturing. The major objective of the inspection and test element is to identify and correct production engineering documentation and practices which would otherwise lead to unsatisfactory materials, parts, subassemblies, and assemblies becoming the basis for high volume production. Whereas plans and controls described in Chapter 4 dealt with the quality controls aimed toward the prevention of defects, the descriptions in this section cover the planning for procedures and physical determination which assure that parts, materials, equipment, subassemblies, and assemblies conform to the drawings and specifications. In general, inspection and test is the examination or measurement of equipment to compare it with specification and/or contract requirements. Inspection and testing must include consideration of tolerances, allowances, limits of size, and various forms and fits. It also must consider various kinds of inspection (e.g. trial run, pilot piece, sampling, percentage, functional, endurance, destructive, piece work, computer programming). Of prime importance is the requirement to maintain quality and uniformity of product throughout the production cycle.

Inspection and test planning must include, but is not limited to, requirements for the following:

- The identification and description of inspections and tests which assure that the manufacturing process produces equipment which meets system specifications:

- The identification and description of the records and reports which document the results of inspection and test;
- Quantification of inspection and test resources scheduled by time and place;
- The identification and description of the government/contractor representation and interrelationships for conduct of the inspections and tests; and
- Technical assistance to design engineering during identification of requirements for inspection and test equipment and development of test procedures.

Figure 6 and the following paragraphs describe the direct relationships among inspection and test and the other elements of production management.

6.2 DETAILED EVENT DESCRIPTION

IT-2 REVIEW CURRENT INSPECTION AND TEST CAPABILITY

Current inspection and test methods and procedures are reviewed for their application to the type program being considered. Although little may be known about the equipment to be designed, it is necessary to identify inspection and test experience along with other production management requirements for use in the program development plan. This should be done prior to the trade-off of alternative systems and equipment. Problems which have occurred during previous program inspections and tests (e.g. endurance and destructive inspections) should be made known. Operational and logistics support experience should be examined to determine the risks on similar programs.

IT-3 DEVELOP INSPECTION AND TEST ALTERNATIVES

Various system and support alternatives require the consideration of inspection and test concepts. These concepts should apply different techniques, equipments, and programming approaches to accomplish inspection and test. Based upon experience, data inspection standards for materials should be reviewed. Techniques for dimension inspection of parts during their manufacture should be reviewed. Advantage should be taken of other studies which have recently examined technological progress. The inspection and test alternatives should be an integral part of the producibility trade-offs described in P-3.

IT-4 ESTABLISH PRELIMINARY INSPECTION AND TEST CONCEPT

A preliminary inspection and test concept is included as part of the production concept (PM-4) selected as a result of the producibility trade-offs (P-3). It will be the basis for the definition of further inspection and test requirements. The inspection and test concept will include, but is not limited to, such things as:

- Estimated inspection and test locations;
- Schedule milestones for the inspections and tests;
- The criteria for and relationships of organic and contractor inspection and tests during experimental, initial production, and follow-on production;
- The documentation techniques to be used;
- Preliminary facilities estimates;
- Special equipment, personnel, and training criteria which may be required for inspection of risk elements;

- Preliminary inspection and test cost estimates; and
- Control data requirements for inspection and test documentation necessary to configuration quality and cost controls.

The inspection and test concepts should be included in the production concept package (PM-4).

IT-5 ESTABLISH INSPECTION AND TEST PLAN REQUIREMENTS

Inspection and test plan requirements must be developed for inclusion in PM-5. They are the basis for development of more detailed inspection and test plans and specifications during the contract definition phase. The requirements must identify service and contractor responsibilities for inspection and test actions during the production program. These requirements include:

- Definition of the inspection and test practices to be considered in the proposals;
- Inspection and test milestones and interfaces to other elements;
- Guidelines and specifications for demonstrating the inspection and test procedures early in the production program.
- Selected methods and analytical techniques to be used;
- Criteria for and limitations of government representation during contractor inspection and test;
- Methods by which records and reports will be acquired and documented; and
- Procedures and specifications for documenting the analyses and other detailed and summary data requirements.

IT-7 ESTABLISH EVALUATION CRITERIA

The criteria to evaluate inspection and test plans should include responsiveness to all requirements previously defined in IT-5. The criteria should also include compatibility with the producibility specifications, plans and controls, relative ability to effectively limit defects in equipment and procedures, and comparative risk to schedules and cost.

IT-8 EVALUATE THE INSPECTION AND TEST PLAN PROPOSALS

The inspection and test plan proposals are evaluated in accordance with the criteria established in IT-7. The evaluation results are included in the production plan proposal evaluation (PM-8).

IT-9 APPROVE INSPECTION AND TEST PLAN

Inspection and test plans are approved for further definition of procedures during the development phase.

IT-10 PREPARE PRELIMINARY INSPECTION AND TEST PROCEDURES

Inspection and test procedures will be selectively prepared to fit the manufacturing processes, personnel skills, equipment and tools, materiel item requirements, and schedules essential to integrated inspection and test of all hardware items throughout their life cycle. The documentation will specifically include means for maintaining change and cost control of the inspection and test procedures. It must include the interrelationships among the subcontractor, contractor, project, and command functions to assure management visibility throughout equipment design and production unit inspections and tests.

IT-12 CONDUCT INSPECTION AND TEST OF ENGINEERING
TEST COMPONENTS

During fabrication and assembly of the production items (M-10 to -12-A), inspections and tests are conducted in accordance with the procedures required by IT-10. To the maximum degree practical, computer programming techniques should be considered during this experimental production phase. Numerically controlled measuring devices which measure distortion, shrinkage, and surface variations may be used for the tests. Program tapes and other records of inspections and tests must be kept for evaluation purposes.

IT-13 and -14 CONDUCT SUBSYSTEM AND SYSTEM INSPECTION AND TEST

Subsystem and system inspections and tests may cover endurance, destructive, assembly, and procedural demonstrations on the prototype systems. Inspection procedures should be followed explicitly and records kept on all deficiencies. Inspection and test technician-to-engineer interface should be maintained throughout the demonstration to assure that design/support changes are correctly incorporated into the inspection procedures and drawings. Where necessary, retesting should be conducted to assure that the revised specifications and procedures are verified and approved prior to establishing the proposed product base.

IT-15A UPDATE INSPECTION AND TEST PLANS AND PROCEDURES

The inspection and test plans are updated to include all changes resulting from inspections and tests of prototype equipment. The revised plans and procedures should be closely interfaced with plans and controls established in PC-15A. Changes which may affect the overall production goals will be included

for evaluation in the updated producibility plan (P-15). The updated inspection and test plans and procedures become an integral part of the requirements for the initial production of equipment (PM-15A).

IT-15B ESTABLISH REQUIREMENTS (FOLLOW-ON PRODUCTION)

Concurrently with preparation of inspection and test plans and procedures for the initial production equipment, inspection and test plan requirements must be established for inclusion in the production contract definition plan (PM-15B). The requirements should be similar to those described in IT-5. They should be expanded to include follow-on production requirements such as the criteria for the interfaces among the commands, projects and contractors, policies, and procedures for inspection and tests and schedule and change control system responsibilities. Management visibility requirements for identifying schedule slippages and defective parts or equipment should be included. These plan requirements should be provided for inclusion in the request for proposals for follow-on production (PM-15B).

IT-16 CONDUCT INSPECTION AND TEST OF INITIAL HARDWARE COMPONENTS

Inspection and test procedures are applied during fabrication of the first test units. Inspection and test control points should be established between projects and prime, associate, and subcontractors. Rigid control system disciplines should require immediate corrective action on defects. Results from the inspections and tests should be evaluated and effective corrective action taken through quality control procedures to prevent defects during follow-on production. Drawings, specifications, procedures, work cards, and other production engineering documentation should incorporate accurate and detailed inspection and test requirements.

IT-17A CONDUCT FIRST ARTICLE INSPECTION AND TEST

Test and inspection technician support should be provided for the first article acceptance. Records should be maintained on all actions and deficiencies. Specific change actions must be accomplished where inspection and test procedures are found to be deficient. Management records should cover such things as:

- The adequacy of the inspection and test procedures to measure and demonstrate the hardware to the production specifications;
- Achievement of the inspection and test effort to the scheduled milestones;
- The adequacy of manual and/or mechanized inspection for making determinations of hardware acceptance; and
- Compatibility of the communications and documentation interface for uninterrupted flow of data on manufactured units.

IT-17B EVALUATE AND APPROVE FOLLOW-ON PRODUCTION INSPECTION AND TEST PLANS

Proposed inspection and test plans should be evaluated and scored. The evaluations should be based upon the requirements established in IT-15B. They should consider changes made during first article inspections and tests on the initial hardware. Coordination should be maintained to assure that inspection and test requirements are thoroughly understood by all government and contractor participants. The updated inspection and test plans are the basis for requirements in follow-on production contracts.

IT-18 to -22 PROVIDE INSPECTION AND TEST SUPPORT AND
UPDATE PLANS AND PROCEDURES

Inspection and test support is provided during fabrication, assembly, delivery, installation, and checkout of the equipment provided for service tests. The inspections and tests must be in accord with previously negotiated contract requirements. Combinations of contractor and service inspection and test personnel may be utilized during this period. It is mandatory that the change control system provide for rapid technical and management review of defects found during inspection and test of the initial operational test units. The defects should be recorded, evaluated, and corrective action taken for high volume production. The inspections and tests must be accomplished in schedule balance with all other production element actions. Management visibility of slippages which may affect the production program is essential. The inspection and test effort is continuous throughout the remaining production and operational phases as required to equip follow-on operating units. Procedures must be continuously updated to provide a baseline for any further modifications or reprocurments which may be required.

IT-24 EVALUATE CHANGE IMPACT

Design, support, and production changes are evaluated for their impact upon the inspection and test procedures, which should be modified as necessary. The adjustments should be in accord with the plans and controls revisions made in PC-24B.

IT-25A CONDUCT INSPECTION AND TEST DURING MODIFICATION

Inspection and test of modified or redesigned equipment is accomplished. These activities should be in accord with previously negotiated ground rules and should include tests of contractor and government support capabilities.

IT-25B UPDATE INSPECTION AND TEST PLANS AND PROCEDURES

Plans and procedures should be updated to include all supplemental information resulting from tests of the first operating organization. These plans and procedures should be included in the production requirements package (PM-25) for use during subsequent government and contractor support effort. Together with the management techniques employed during the production cycle, they should be furnished as information for future planning (CD-18B to -26). They provide a baseline for ongoing production tests and should be included in DoD-Industry preparedness plans.

EQUIPMENT AND TOOLS

Interface Responsibilities:

- Producibility Characteristics in Design and for Use
- Plans and Controls for Production Concepts, Actions, Requirements, and Equipment and Tools Analysis
- Manufacturing Processes, Requirements, and Limitations
- Inspection and Test Requirements and Specifications
- Facilities Plans, Design Characteristics and Use
- Industrial Support Plans, Techniques, Requirements, and Available Resources
- Personnel and Training Requirements and Human Interface Evaluations
- Funding Requirements, Allocations, and Cost Criteria
- Control Data Needs and Use for Evaluation of Equipment and Tools Performance, Improvement and Management

7. EQUIPMENT AND TOOLS

7.1 INTRODUCTION

The equipment and tools element must assure the availability of required equipment and tools to perform production and common support functions at all locations for the lowest overall cost during the equipment life cycle. The ability to perform planned manufacturing actions and unscheduled maintenance actions, which may cause downtime on production equipment, depends on the adequacy of equipment and tools identified and developed concurrently with the prime system and logistics support resources.

Equipment and tools consist of all the machine tools, jigs, fixtures, handling and test equipment necessary to support the entire production process. They may be categorized into special (peculiar to the program being considered) and common (commercially available or currently in government inventory) groupings. Consideration for the common use of equipment and tools must be included in the operations, logistics support, and production planning. Where feasible, existing and/or standard equipment and tools should be used to achieve program cost benefits. This must be done without jeopardizing operational and support performance and readiness.

The equipment and tools planning events and their sequential relationship to the other elements of production management are shown in Figure 6.

7.2 DETAILED EVENT DESCRIPTION

ET-2 PROVIDE CURRENT EQUIPMENT AND TOOLS ESTIMATE

Included in the production capability estimate (PM-2) is an assessment of tools and equipment used to conduct similar production efforts at various subcontractor, contractor, and government locations. The estimate should consider recent advances in techniques for the design and fabrication of equipment and tools as well as their use in experimental and operational test programs. Assessments should include uses of computer controlled equipment for manufacturing, inspection, and test processes.

ET-3 DEFINE EQUIPMENT AND TOOLS ALTERNATIVES

Equipment and tools trade-off studies are conducted to satisfy the alternative production concepts being considered (P-3). As part of the producibility trade-offs, consideration is given to available equipment and tools experience (ET-2). These trade-offs should consider the technical feasibility of numerical control programming and other new techniques. The overall cost and desirability of developing new equipment and tools to manufacture components for several different systems must be considered.

ET-4 ESTABLISH PRELIMINARY EQUIPMENT AND TOOLS CONCEPTS

Equipment and tools concepts are selected on the basis of maintainability, reliability, cost, and producibility trade-offs (P-3), and in accord with the plans and controls concepts (PC-3). These concepts are documented in the form of equipment and tool requirements needed to support anticipated production rates. They are the basis for the initial plan requirements (ET-5). They also must satisfy the selected system and support concepts (SD and SM-4). The concepts are documented for inclusion in PC-4.

ET-5 ESTABLISH EQUIPMENT AND TOOLS PLAN REQUIREMENTS

As part of the production plan requirements (PC-5 and PM-5), equipment and tools planning criteria is defined for:

- Types and combinations of machine tools and groupings required for the manufacture of the prime equipment and support resources;
- Special fabrication, inspection, and test equipment and tools;
- Use of available plant equipment and tools;
- Funding of new or additional equipment and tools;
- Development and acquisition plan for acquiring and/or fabricating new equipment and tools;
- Plan for additional quantities of contractor/government furnished equipment and to ; and
- Schedules, responsibilities, and interface requirements for contractor/government relationships during the acquisition and use of equipment and tools.

ET-7 ESTABLISH EQUIPMENT AND TOOLS PLAN EVALUATION CRITERIA

Evaluation criteria are developed for determining the competing contractors' responsiveness to the equipment and tools plan requirements (ET-5). The evaluation criteria should also cover the identification of and justification for proposed special equipment and tools, equipment and tools maintainability, common utilization for production and logistics support, and the cost to design, develop, and procure recommended special equipment and tools. The evaluation criteria are included in PM-7 for overall production proposal scanning.

ET-8 EVALUATE EQUIPMENT AND TOOLS PLAN PROPOSALS

The equipment and tools plans should be evaluated against the criteria established in ET-7. Evaluation results are included as part of PM-8.

ET-9 APPROVE EQUIPMENT AND TOOLS PLAN

An equipment and tools plan is approved for use and further definition during the development phase. It becomes part of the production plan (PM-9) for inclusion in the development contracts (SD-10A). It authorizes the contractor to proceed with development of production equipment and tools in quantities required for fabrication, assembly, and tests during development. Based upon lead times for experimental production, action is initiated for procurement of special equipment and tools in the quantities estimated to be required. All special and common equipment and tools are evaluated for make or buy decisions. Procurement action is scheduled to meet fabrication, assembly, and test need dates.

ET-10 UPDATE REQUIREMENTS AND BEGIN DESIGN

The equipment and tools requirements and plans are modified and updated continuously to agree with changes to design, new design, and the plans and controls requirements (PC-10). The selection of equipment and tools for experimental production should be compatible wherever feasible with those anticipated for production of operational units. Continual interface actions are required among system design, support, and production engineering to assure that common equipment and tools can be utilized where possible. Equipment and tooling design is accomplished as a result of the emerging system, support and production requirements (SD-10, SM-10, and PC-10).

ET-11 EVALUATE SPECIFICATIONS AND SYSTEM DESIGN

Specifications for equipment and tools are evaluated against program equipment design and logistics support system design to assure that all interface requirements are met.

ET-12 to 14 UPDATE EQUIPMENT AND TOOLS SPECIFICATIONS AND DRAWINGS

Changes resulting from system, subsystem, and support testing are evaluated for their impact upon the equipment and tools. Equipment and tools specifications and drawings are updated to agree with changes to system and support design.

ET-15 PROVIDE EQUIPMENT AND TOOLS PLAN REQUIREMENTS (OPERATIONAL UNITS)

The requirements for equipment and tools are included as part of the contract definition plan for production (PM-15B). These requirements should be similar to those of ET-5 as modified by the experience gained during fabrication and demonstration of experimental test units. They should include the results of the latest specifications and drawings changes in ET-12 to 14.

ET-16 UPDATE DESIGN AND PROVIDE EQUIPMENT AND TOOLS (INITIAL PRODUCTION UNITS)

Equipment and tool design drawings and specifications are updated by changes resulting from review of the proposed product baseline. Special tools are fabricated or procured for the production effort. Long lead item equipment and tools should be fabricated or procured early in development. This action is required to maintain schedule balance for production of initial units.

ET-17 EVALUATE CHANGES AND MODIFY THE EQUIPMENT AND TOOLS FOR FOLLOW-ON PRODUCTION

Changes resulting from the first article inspection should be evaluated for their impact upon the equipment and tools. Rapid modification action must be accomplished to make equipment and tools available for follow-on production. All revised specifications and drawings become part of the product baseline for review and approval of the configuration and for funds release for equipment and tools needed for follow-on production.

ET-18 EVALUATE CHANGE IMPACT ON EQUIPMENT AND TOOLS

Changes resulting from service test of the prime system and support requirements should be evaluated for their impact on production equipment and tools. Common equipment and tools to be used later during user operational and maintenance activities should be evaluated for performance relative to meeting system maintainability and availability requirements.

ET-19 UPDATE EQUIPMENT AND TOOLS REQUIREMENTS

The equipment and tools requirements are updated to provide configuration compatibility with the prime system design and logistics support resources. Equipment and tools are modified or procured as required to meet the changed requirements.

ET-20 PROVIDE COMMON EQUIPMENT AND TOOLS

Common equipment and tools required for government maintenance or for combined government and contractor use in preparing for operational suitability demonstration should be delivered as scheduled. The equipment and tools may be used for inspections and tests, assembly, installation, checkout, modification, and

maintenance actions. Contractor to government phaseover plans should include all requirements and actions.

ET-23 EVALUATE CHANGE IMPACT ON EQUIPMENT AND TOOLS

Production plans and control changes resulting from the operations and support evaluations conducted during the operational suitability demonstrations should be reviewed and evaluated for their impact on equipment and tools. Recommendations should be included in the production management evaluations (PM-23).

ET-24 UPDATE EQUIPMENT AND TOOLS REQUIREMENTS

Production change requirements (PM-24B) developed as a result of the decision to modify the system and equipment (SD-24B) may require changes to the equipment and tools. These changes should be in accord with the revised plans and controls (PC-24A).

ET-25 PROVIDE EQUIPMENT AND TOOLS FOR MODIFICATIONS AND FUTURE PRODUCTION

Supplemental information resulting from tests and modifications are incorporated into the equipment and tools plan. New or modified equipment and tools are provided for field or future production use. The updated requirements should be furnished as control data to future production planning.

F A C I L I T I E S

Interface Responsibilities:

- o Producibility in Design Characteristics and Use Evaluation Criteria
- Plans and Controls for Concepts, Actions, Requirements, and Facilities Evaluations
- o Manufacturing Processes, Requirements, and Limitations
- o Inspection and Test Requirements and Limitations
- o Equipment and Tools Design Characteristics, Plans, and Requirements
- o Industrial Support Requirements, Forecast Availability, and Critical Item Limitations
- o Personnel and Training Concepts, Plans, and Human Interface Evaluations
- o Funding Requirements, Allocations, and Cost Criteria
- o Control Data Needs and Use for Evaluation of Facilities Performance, Improvement, and Management

8. FACILITIES

8.1 INTRODUCTION

The facilities element assures the availability of required facilities for experimental, initial, and follow-on production activities. Facilities planning is based on the combined operations, maintenance and production analyses, the prime equipment drawings and specifications, and all production documentation. It defines the type of facilities, locations, space needs, environment, duration and frequency of use, and personnel facility interfaces, and incorporates the installation, assembly, test, and fabrication activities needed for the production program.

Schedules for development, construction, and activation of facilities should consider construction delay experience caused by seasonal weather and other effects such as labor negotiations, soil conditions, etc. Facilities planning for production requires close management attention through all phases of the equipment life cycle. Positive coordination with all other project elements is required. Early determinations of ownership and joint utilization plans for facilities should be made.

The facilities planning events and their relationship to the other elements of production management are shown in Figure 6.

8.2 DETAILED EVENT DESCRIPTION

FA-2 PROVIDE CURRENT FACILITIES ESTIMATE

Assessments are made of existing facility capabilities for producing similar systems and equipment. This assessment is

based on available production experience data (CD-2). Consideration should be given to:

- Initial facilities trade-offs (FA-3) which define production locations, common use, duration and frequency, etc.;
- Facility selection ground rules (e.g., consideration of required material resources by type, quantity, and location as well as construction force needs in terms of skills, numbers, and availability);
- Constraints to be considered for the type of facility and the arrangements of equipment and tools; and
- The proximity of materials and transportation services needed to maintain quantity production.

The preliminary facility estimates are included in 1-2.

FA-3 PERFORM FACILITIES TRADE-OFF

System feasibility, support, and producibility trade-offs are evaluated for their impact on current facilities. Facility trade-off studies are conducted by the government or contractor to identify alternatives in filling new requirements. The trade-off approaches should consider use of contractor or government facilities, machine groupings for which facilities space must be provided, proximity of existing facilities to locations for fabrication, assembly and installation of manufactured parts, and the comparative life cycle cost and budget estimates for the acquisition of facilities including downstream use and disposition value.

FA-4 ESTABLISH FACILITIES CONCEPT

The facilities concept is selected on the basis of the producibility trade-offs (P-3) conducted concurrently with the system and support feasibility studies (SD and SM-3). The facilities concept is included in the preliminary production concept package (PC-4).

FA-5 PROVIDE FACILITIES PLAN REQUIREMENTS

Facilities plan requirements are prepared for inclusion in PM-5. They include, but are not limited to:

- Criteria for contractor and government owned facilities to produce experimental and follow-on systems and equipment;
- Real estate and construction specifications;
- Combined production/support facilities requirements for modifications, procurements, depot level activities, etc.;
- Phasing plan criteria for use and disposition of industry and government facilities;
- Life cycle cost and budget estimates for the funding schedule (F-5); and
- Location guide.

FA-7A SELECT, SCHEDULE AND/OR DESIGN FACILITIES

Procurement lead time and construction of initial production facilities requires early project action to develop facility design specifications. This architect-engineering task may be

accomplished by government or contractor in accordance with program needs and current service instructions and procedures.

FA-7B ESTABLISH FACILITY PLAN EVALUATION CRITERIA

Technical and management evaluation criteria are developed for determining the adequacy of the facility plan requirements (FA-5) and the architect engineering design specifications (FA-7A). These criteria, as part of (PM-7B), include the factors necessary to evaluate:

- Functional performance characteristics for production facilities (e.g., installed equipment reliability, maintainability, useful life, environmental design and transportability);
- Definitive design and construction specifications, standards, and constraints;
- Detailed facilities concepts for common and special production support (e.g., functional requirements, production policies, survival requirements, and policies, etc.), siting and layout (e.g., area plans and site plans such as access paving and drainage, contours, volume requirements, etc.), and civil, architectural, structural, mechanical, and electrical requirements; and
- Function, schedule, and management controls for those facilities requiring experimental and initial production construction and testing (e.g., critical installed equipment, environmental control, electrical power, proof and destruction testing, and any other similar criteria).

FA-8 EVALUATE FACILITY PLANS

The contractor or government proposed facilities plan should

be evaluated for responsiveness to the requirements (FA-5), identification of and justification for new facilities, and cost to design, develop and acquire the proposed facilities.

The evaluation ratings, recommended changes to requirements and schedules, allowable deviations, and contractor recommended revisions should be included in the production management evaluation report (PM-8).

FA-9 APPROVE PRODUCTION FACILITIES

Proposed facilities construction is approved and funds are allocated for experimental and long lead initial production facilities. Facilities design is completed and construction bids are solicited for the initial facilities. Programming action is initiated to request tentative funds authorization for follow-on production facilities. This action is based upon the type of procurement and scheduled use of facilities.

FA-10A BEGIN FACILITY CONSTRUCTION (PROTOTYPE)

Selection of the best construction bid marks the beginning of facility construction. Continuous surveillance over development of all system design, logistics support, and production requirements is needed to ensure that design and support changes are given proper consideration for their impact on facilities. Changes impacting facilities require reevaluation of funds and schedules by all production management elements.

FA-10B VERIFY AVAILABILITY OF INITIAL FACILITIES (MANUFACTURING)

Initial production facilities are evaluated for their compatibility with the plan requirements. Progressive reviews for facility adaptability to system design, support and production

requirements identified during installation, checkout, and test of facility equipment are evaluated and corrective action is initiated.

FA-11 VERIFY AVAILABILITY OF FACILITIES (EXPERIMENTAL TEST)

Facilities for experimental proof and destructive testing and the subsystem and system demonstrations are evaluated for their compatibility with plan requirements and their capability to satisfy system, support, and production testing requirements. Changes identified during use of these facilities are evaluated and corrective action is initiated.

FA-12 APPROVE TENTATIVE PRODUCTION FACILITY PROGRAM (INITIAL UNITS)

Where follow-on production requires the ownership or combined use of government/contractor facilities, approval must be given for their construction. Provisions are made to incorporate configuration changes into these facilities as the experimental production testing progresses.

FA-15A VERIFY AVAILABILITY OF FACILITIES (INITIAL PRODUCTIONS)

Availability of initial production facilities will be verified prior to contract awards for production of initial increments of the operational system. In some cases, program decisions may require use of existing contractor facilities for initial production. Where trade-off studies show an advantage to the government, follow-on production facilities may be separately developed.

FA-15B ESTABLISH FACILITIES DEFINITION PLAN
(FOLLOW-ON PRODUCTION)

Where it can be shown as an advantage to the government to provide facilities for multiple program use, optional facilities definition plans may be prepared for bid proposal as part of the follow-on production proposal package. This plan should consider requirements similar to those itemized in FA-5. The requirements should be expanded to include follow-on production facility needs. They should be in accord with the plans and controls requirements established in PC-15B, including early scheduling for long lead production.

FA-16A EVALUATE FACILITIES PROGRAM (INITIAL PRODUCTION)

Facilities programmed for initial production will be evaluated during the manufacture of initial hardware. A close interface will be maintained among system, support, and production elements during these evaluations so that changes are reviewed and new facilities requirements identified in a timely manner.

FA-16B PREPARE FACILITIES BID PROPOSALS

Selected contractors complete proposals for production facilities required to produce follow-on equipment (FA-15B).

FA-17A EVALUATE FACILITIES PROPOSALS

Facility proposals submitted by the contractors are evaluated and a contractor selection made. The selected proposal will become part of the product baseline for approval of final configuration and funds release for facilities.

FA-17. INITIAL CONSTRUCTION-FOLLOW-ON FACILITIES

Facility construction will be released to meet lead time requirements. Equipment and tools installation, checkout, and testing for these facilities will be accomplished prior to initiating follow-on production.

FA-18 ACTIVATE PRODUCTION FACILITIES

Incorporation of changes resulting from review of the product baseline configuration and the user service tests marks the point of acceptance of facilities for follow-on production. Facility design will be further tested and verified during the initial manufacturing actions.

FA-21 UPDATE FACILITIES PLAN

The facilities plan is updated to provide guidance for later production activities (PM-21B). Critical volume requirements, rearrangements of machine groupings to support follow-on schedules, identification of special interface requirements between contractor and government elements, and other special requirements are included.

FA-23 EVALUATE CHANGE IMPACT ON FACILITIES

Changes resulting from the operational suitability demonstrations should be reviewed and evaluated for their impact on facilities. Recommendations will be included in the production evaluations (PM-23).

FA-24A MODIFY FACILITIES

Production change requirements (PM-24B), made as a result of the decision to modify the system and equipment (SD-24B), may

require some change to the facilities. These changes must be compatible with the revised production plans and controls requirements (PC-24A). Facility modifications and support for those modifications will be in compliance with previously negotiated contracts.

FA-24B UPDATE FACILITIES REQUIREMENTS

Supplemental facilities information resulting from the previous actions is incorporated into the facilities plan. The updated plan is provided as part of the overall production management package (PM-25). It is used during subsequent service or contractor support efforts. It should include all management procedures and technical information to be employed during the remaining production period. The plan should be furnished to control data for future project planning (CD-18B to 26). It also should be used as part of baseline data for future DoD-Industry production preparedness planning.

I N D U S T R I A L S U P P O R T

Interface Responsibilities:

- o Producibility Considerations in the Selection, Control, and Use of Industrial Support
- o Plans and Controls for Requirements, Configuration, Quality, Cost, and Schedule Balance
- o Manufacturing Processes, Actions, and Interfaces
- o Inspection and Test Procedures, Locations and Limitations
- o Equipment and Tools Lists, Locations and Use Plans
- o Facilities Layouts, Locations and Use Plans
- o Personnel and Training Availability and Use
- o Funding Requirements, Allocations, and Cost Criteria
- o Control Data Requirements for Experience and Performance Measurement

9. INDUSTRIAL SUPPORT

9.1 INTRODUCTION

Rapidly advancing technology, the advent of larger and more sophisticated weapons systems, and the urgency to maintain our country's defense position have brought about new demands for a closer teamwork between industry and government. This provides us with a challenge to deliver highly reliable and maintainable systems and equipment on time and at least total cost. Our complex systems and equipment encompass every field of manufacturing expertise. They involve multitudes of suppliers. The suppliers, in applying their special skills and knowledge, must meet the system requirements. The government must outline the requirements in sufficient technical detail to insure an effective system. In most complex systems, a continuing series of government-contractor iteration of the requirements at ever increasing levels of detail is necessary. These actions demand an interdependence among service projects, commands, and contractors such that each opportunity to reduce costs or improve the product must be evaluated with respect to the impact on the total system.

Industrial support is the element of production management within government and industry projects and functional organizations that maintains general continuous surveillance over, and assessment of, the combined production materials and resources essential to the acquisition and use of all current systems and equipment. The industrial support element within government and industry projects controls the selection and programming of materials and other resources essential to a project's production

processes. It includes the planning events, decision points, and interfaces essential to:

- Establish effective relationships among projects, prime contractors, associate contractors, subcontractors, and procuring elements;
- Establish priorities for critical materials distribution;
- Control multiple orders for common and special items;
- Establish standard and state-of-the-art manufacturing processes and controls;
- Establish systems for regulating and reducing costs and changes for multiple program production activities; and
- Resolve conflicts among government, military, and private sectors of the economy.

Figure 6 and the following paragraphs describe the events, decision points, and relationships of the industrial support elements to project management and its elements.

9.2 DETAILED EVENT DESCRIPTION

IS-2 PROVIDE CURRENT ASSESSMENT

Estimates of industrial support capabilities for systems and equipment having similar production requirements must be provided to assure their proper consideration in the system feasibility studies. As overall systems specifications and production concepts are defined, the production requirements will be analyzed to determine the degree to which they are fulfilled by existing industrial support capability. The current industrial support capability estimate is essential to this analysis (PM-3).

Industrial support assessments should include summaries of problems and deficiencies previously experienced on similar production programs. They should cover priorities for obtaining materials, capabilities of similar system production teams, techniques and policies for material ordering, and collection and evaluation of techniques (e.g., value engineering, cost reduction, change control, performance measurement, resource criticality, and advanced production techniques). The assessment should cover both the techniques required by DoD directives and guides and advanced techniques developed or being developed by public and private technical management specialists. Source information for these considerations may be found as part of the production experience data (CD-2). Information applying directly to a particular system and equipment project should become part of the current production capability estimate (PM-2).

IS-3 DEVELOP INDUSTRIAL SUPPORT ALTERNATIVES

Industrial support alternatives are defined and analyzed. These alternatives will specify different ways and means of using the total national industrial resources and controlling their priorities. They will assist in developing the concepts being studied in P-3.

IS-4 ESTABLISH INDUSTRIAL SUPPORT POLICIES

Industrial support policies are documented concurrently with the selection of a preliminary production management concept (PM-4). They provide guidance for further definition of production requirements. Depending on the depth of definition required, the industrial support policy should include criteria for:

- The relationship between government and contractor production units during production resource development;
- The priorities and scheduling of critical materials;
- Application of techniques and information (IS-2);
- Government plant representation;
- Utilization and control of programming techniques such as numerical tool control; and
- Inter-projects, inter-services, and government inter-agency support.

IS-5 DEVELOP INDUSTRIAL SUPPORT PLAN REQUIREMENTS

Industrial support plan requirements must be developed for inclusion in PM-5. These requirements become the criteria for development of the industry and government portion of the proposed plans during the contract definition phase. The requirements must identify both the government project and contractor manager responsibilities for development and use of industrial support to production. They must specifically call for all, or portions of, existing directives, instructions, and procedures which apply to the industrial support concepts (IS-3).

IS-7A ESTABLISH INDUSTRIAL SUPPORT MANAGEMENT PLAN

Industrial support management criteria are established in the production management plan (PM-7A). Organizations, responsibilities, interfaces, and working procedures must be identified for such things as:

- Industrial support application to the equipment project;
- Critical item control;

- Review and allocation of materials (i.e., priority and schedule balance);
- Government/contractor interface (i.e., plant representation, production commodity item procurement, and inventory, etc.); and
- Procedures and controls for government furnished equipment, property, and data.

The industrial support management plan will also include related funding and schedule information.

IS-7B ESTABLISH EVALUATION CRITERIA

Evaluation criteria are established for comparing and rating contractor responses to the policies and requirements previously described. These criteria are included in the production management evaluation documentation (PM-7).

IS-8 EVALUATE PROPOSED PLANS

The source selection board evaluates all industrial support plans as part of production management evaluations (PM-8). Industrial support elements are evaluated and scored for their responsiveness to the criteria and requirements.

IS-9 APPROVE INDUSTRIAL SUPPORT PLAN (TEST UNITS)

The selected industrial support plans are approved as part of the production development plan. They should be updated to reflect the results of contract definition and the management plan requirements covering the controls, policies, funding, schedules, and responsibilities for industrial support. The industrial support plan should include specific information on

the detailed concepts and requirements previously outlined in IS-4 and -5. It should include specific reference to specifications, or portions thereof, which apply to resource use controls such as configuration, schedule, quality, cost, data, inventory, procurement, materiel, manpower, budget and finance, and security. The interfaces with all production management elements should be defined.

IS-10A PREPARE INDUSTRIAL SUPPORT ACQUISITION DOCUMENTS
AND ALLOCATE RESOURCES (EXPERIMENTAL TEST)

Concurrent with the manufacture of test units and the production planning for initial operational units, documentation should be established for acquiring and allocating materials and resources for engineering test. This documentation provides guidance to production management for review and allocation of materials and other production resources in accord with the schedules and the production engineering analyses described in FC-10. It places emphasis on the distribution of common resources used in support of development. It initiates the early government-to-contractor relationships which control the materials, major and minor items, work force, materials ordering process, performance, value, change control systems, and specific make/buy apportionments.

IS-10B ESTABLISH INDUSTRIAL SUPPORT PLAN (INITIAL PRODUCTION)

As a continuing effort throughout early experimental production, the detailed documentation developed in IS-10A should be reviewed, evaluated, and updated and specific plan requirements should be defined for initial production.

IS-14 UPDATE INDUSTRIAL SUPPORT DOCUMENTS (ENGINEERING TEST)

Industrial support documentation is updated to reflect any requirements changes resulting from system demonstrations. Evaluation and approval by system design, logistics support, and production management is required.

IS-15A UPDATE INDUSTRIAL SUPPORT PLAN (INITIAL PRODUCTION)

The revised industrial support documents (IS-14) become the basis for an updated industrial support plan proposed for initial production.

IS-15B ESTABLISH PLAN REQUIREMENTS (FOLLOW-ON PRODUCTION)

Concurrent with the establishment of a proposed product baseline configuration, industrial support planning is accomplished for follow-on production units. This planning should be accomplished in time to guide long lead item releases for material and other factors essential to follow-on production (PM-15B).

IS-16 ALLOCATE RESOURCES (INITIAL PRODUCTION)

Industrial support resources are allocated for initial production in accord with the industrial support plan (IS-15A). The allocations and their control are based upon the plans and controls requirements (PC-16).

IS-17A EVALUATE FIRST ARTICLE CHANGES

Industrial support evaluations should be conducted to determine the impact of first article test changes upon commodity items or other common resources to be used for future production. These changes are reviewed for interface effect upon other projects or contractor activities which may be involved in similar system and equipment development.

IS-17B EVALUATE PROPOSED PLANS AND ALLOCATE RESOURCES

The industrial support requirements are updated and resources allocated as a result of product baseline approval. All industrial support interfaces with other production management elements and the assignment of responsibility for delivery and use of industrial support resources should be reviewed for their adequacy in supporting the production program.

IS-19 UPDATE INDUSTRIAL SUPPORT PLAN

During initial unit production and service test, the industrial support plans are evaluated for use in follow-on production. Liaison actions and communication channels among plant representatives are reviewed for their ability to maintain established schedules. Where schedule slippages occurred due to the improper delivery or use of material items, management action should be taken to develop appropriate recovery plans and all these plans should be reflected in the updated industrial support plan.

IS-23 EVALUATE CHANGE IMPACT

Deficiencies in follow-on production, equipment operation, and logistics support should be evaluated for their impact upon the industrial support plans. Trade-off studies should be made among all elements to determine the impact of these deficiencies upon future industrial support planning. Study results should be included in production management decisions for further program action.

IS-24 UPDATE INDUSTRIAL SUPPORT PLAN AND ALLOCATE RESOURCES

Approved requirements changes are included in an updated industrial support plan. This information is utilized by the

systems support commands and contractors to provide planning for further procurements, repairs, or modifications. It is also provided as experience information to project managers engaged in the planning of new systems and equipment. The information should consider reallocation or disposition of industrial support resources based upon operational changes, equipment obsolescence, and other operations and support factors. Alternative industrial support plans should be included in any production preparedness planning and should cover expected future contingencies.

CHAPTER 10

P E R S O N N E L A N D T R A I N I N G

Interface Responsibilities:

- o Producibility Requirements and Personnel Performance Demonstration Criteria
- o Plans and Controls Including Concepts, Policies, Tasks, Times, and Demonstration Procedures
- o Manufacturing Processes, Tasks, Procedures, and Policies
- o Inspection and Test Policies, Procedures, and Limitations
- o Equipment and Tools Drawings, Specifications, and Operations and Maintenance Requirements
- o Industrial Support Requirements and Policies
- o Facilities Requirements for Special Skills and Training
- o Funding Requirements, Allocations, and Cost Criteria
- o Control Data Requirements for Experience and Performance Measurement

10. PERSONNEL AND TRAINING

10.1 INTRODUCTION

The personnel and training element defines the requirements for, selects, and trains the personnel needed to produce the system and equipment. Early in the system and equipment life cycle, realistic estimates of current production manning capabilities must be made. These estimates are made in terms of the numbers and skills needed to produce similar systems and equipment. As alternative hardware concepts are developed, system design and logistics support decisions must be made with due consideration for their impact on the production manpower and training requirements. The selected requirements are translated into specific manning documents in terms of numbers of personnel and the types of production skill classifications needed. Early projections of training requirements should be made. Training requirements should consider system and equipment complexities and production lead times so that training can be completed prior to the time maximum production rates are established. Personnel requirements established by the contractor, government, and services should be evaluated against manpower availability. All deficiencies should be corrected by training actions and timely manpower commitments to maintain production schedule balance.

Figure 6 and the following paragraphs cover the events and relationships among personnel and training and the other elements of production management.

10.2 DETAILED EVENT DESCRIPTION

PT-2 PROVIDE CURRENT PERSONNEL AND TRAINING ESTIMATE

Estimates of personnel available for production of the specific system or equipment should be developed. These personnel and training estimates are predicated upon current and similar equipment production experience. These estimates are recorded in terms of quantities, skills, special training requirements, and overall trend curves depicting the availability of trained personnel during the expected life cycle. The information must be included in the production capability estimates (PM-2).

PT-3 DEVELOP ALTERNATIVE PERSONNEL AND TRAINING CONCEPTS

Estimates of the personnel and training requirements are made to support the various producibility trade-off study alternatives (P-3). Consideration must be given to the expected tasks, identification of skills, manpower availability (PT-2), special training needs, availability of training facilities, and the impact of the requirements on other production elements.

PT-4 ESTABLISH PERSONNEL AND TRAINING CONCEPT

Personnel and training concepts are established as a result of the producibility trade-offs (P-3). These concepts should be in accord with the system design and logistics support concepts established in SD-4 and SM-4. The concepts must also be compatible with the plans and controls for production, manufacturing concepts, and the government/contractor interface concepts. They include tentative identification of any special personnel requirements not currently in the production skills inventory,

assessment of conceptual changes to existing personnel use patterns, and evaluation of the tentative impact upon training equipment and facility needs for future production. These personnel and training concepts become an integral part of PM-4.

PT-5 DEVELOP PERSONNEL AND TRAINING PLAN REQUIREMENTS

Personnel and training plan requirements are developed as inputs to PM-5. These requirements include criteria for the development of production personnel and training programs during contract definition. Preparation of request for proposals does not always require definitive production personnel estimates. However, if total package procurement and life cycle cost estimates are required during contract definition, personnel and training estimates must be established by both government and contractor production elements. In support of these requirements and previously established personnel and training concepts (PT-4), the requirements for proposed plans must include:

- Production manning policies and ground rules;
- Criteria for determining and justifying personnel needs;
- Training and use of available industrial personnel;
- Criteria for training equipment design, procurement, fabrication and use; and
- Joint utilization of personnel for production and logistics support.

PT-7 ESTABLISH PERSONNEL AND TRAINING PLAN EVALUATION CRITERIA

Criteria are established to evaluate the contractor responsiveness to the personnel and training requirements (PT-5). They should provide a means of comparison among proposed approaches

for the use of personnel to achieve overall production requirements, the cross-utilization of personnel among logistics support and production organizations, the use of available versus new skills, and subcontracting training versus establishing new training programs and facilities. The evaluation criteria are included in PM-7.

PT-8 EVALUATE PERSONNEL AND TRAINING PLAN PROPOSALS

Personnel and training plan evaluations should include comparison and scoring of the various proposals against requirements and evaluation criteria described in PT-5 and -7. Evaluation results should be included in PM-8.

PT-9 APPROVE PERSONNEL AND TRAINING PLAN

Personnel and training plans are approved as part of the overall production development plan (PM-9). The plans should include the most desirable features of contractor proposals. They should consider the development and user agency plans for interfacing, scheduling, funding, and controlling development of later personnel and training requirements. Manpower trend curves covering the current and projected use of personnel should be included. The plan should describe the means by which contractor personnel and training will be provided to assist with later systems and equipment phaseover into the using commands inventory.

PT-10 to -12A PREPARE PERSONNEL AND TRAINING PACKAGE AND CONDUCT FABRICATION, ASSEMBLY, AND TEST TRAINING (PROTOTYPE)

Production training packages are prepared to record the skills and quantities of production personnel needed to accomplish the tasks defined in the production engineering analyses.

Requirements are correlated to manpower specialty classifications, established personnel learning levels, and performance standards. Identification is made of those particular skills not presently available, and requirements for new training courses, aids, and equipment are identified. Included in the training packages are methods for demonstrating training effectiveness, updating the packages during follow-on production, and plans for the gradual transition of training responsibilities to the system support commands who will later support the system and equipment.

Concurrent with preparation of the training package, training is conducted to satisfy the needs of experimental equipment fabrication, assembly, and test programs and to familiarize advance production personnel with the hardware and cost and schedule requirements. Training lead times should be sufficient to assure that personnel can be trained to perform assigned production tasks without inducing schedule delays. Where practical, contractor and service personnel should be trained together.

PT-11B to -14 PREPARE PERSONNEL AND TRAINING PACKAGE
(INITIAL PRODUCTION UNIT)

Concurrent with the fabrication, assembly, and test of prototype hardware, requirements for personnel and training to support the manufacture of initial production units are prepared. The requirements are included in the contractors' proposed production baseline described in PM-15A. Personnel and training requirements should support all actions needed to accomplish manufacturing, inspection, and test as described in Chapters 5 and 6. In addition, personnel and training requirements also cover materials control, methods study, plant layout, plant maintenance, production planning and control functions, industrial

support functions, quality control, value engineering, safety and fire prevention, stores keeping, work measurement and time study, work simplification, and other functional areas associated with each of the above elements. The personnel training requirements packages as well as the actual conduct of some training must be verified prior to establishing the product baseline (SD-17B).

PT-15 ESTABLISH PERSONNEL AND TRAINING PLAN REQUIREMENTS
(FOLLOW-ON PRODUCTION)

Using the experience gained during fabrication, assembly, and test of the experimental hardware and during development of the personnel and training package for initial production units, personnel and training plan requirements are established for follow-on production. These requirements become part of the production contract definition plan (PM-15B). In addition to criteria similar to those described for previous training packages, they include quantitative and schedule changes necessary to furnish personnel and training for high volume production of follow-on units. Specific requirements for responsibilities, interfaces, schedule balance, funding, and other information essential to contract bid requests are provided.

PT-16 CONDUCT SUPPLEMENTAL TRAINING (INITIAL PRODUCTION UNITS)

Supplemental training is conducted as a result of changes that are approved during establishment of the proposed product baseline. This training should be evaluated and verified prior to incorporation of new training requirements in the proposals being submitted.

PT-17A EVALUATE PROPOSED PERSONNEL AND TRAINING PLANS

Personnel and training plan proposals submitted by the various contractors for follow-on production are evaluated. This evaluation should be accomplished concurrently with the evaluations of all other production management element requirements. The evaluations should include comparisons of the training packages for quality, cost, schedule balance, manpower impact, special training required, and proposed phaseover actions.

PT-17B CONDUCT TRAINING (FOLLOW-ON PRODUCTION)

Based upon the proposed plans, production training is conducted to provide sufficient quantities of personnel with adequate skills for the follow-on equipment production. Training lead times should be sufficient to maintain schedule balance in accord with negotiated requirements. This task is continuous throughout the remainder of production to provide for modification of equipment and personnel replacement.

PT-19 UPDATE PERSONNEL AND TRAINING PACKAGE

Personnel and training plans, procedures, schedules, quotas, and other requirements are updated as a result of evaluations made during the initial production processes and the production support provided to the service tests (SD-18).

PT-21 EVALUATE PERSONNEL AND TRAINING -- ASSEMBLY AND CHECKOUT

Personnel and training evaluations are conducted during equipment delivery, assembly, and checkout in preparation for the operational suitability demonstrations (SD-22). These evaluations may be accomplished on a combined service-contractor basis depending on the negotiated ground rules for use of contractor support.

PT-23 EVALUATE CHANGE IMPACT ON PERSONNEL AND TRAINING

All proposed system design, logistics support, and production changes are evaluated for their impact on the personnel and training requirements. The results are recorded and included in the overall production evaluations (PM-23).

PT-24A UPDATE PERSONNEL AND TRAINING PACKAGES

Personnel and training changes resulting from the operational suitability testing (SD-22) and the manufacturing support (M-22) are included in an updated personnel and training package. Estimated personnel and training resources used for equipping the follow-on operating units are verified. This information is transmitted to the systems/support commands for further procurement planning. It should cover support to normal operations and the production tasks which are to be accomplished at depot or intermediate support areas. Close coordination should be maintained among the logistic support and production elements during this action. The information should be made available to other managers engaged in the production planning for new systems and equipment. Training plans should cover expected contingency conditions.

PT-24B CONDUCT SUPPLEMENTAL TRAINING

Supplemental training is conducted in accord with the updated personnel and training packages (PT-24A). This training should cover government and contractor production tasks to be performed during the remainder of the production cycle.

F U N D I N G

Interface Responsibilities:

Requirements, Allocations, and Accounting
for Funds Used to Provide:

- o Producibility
- o Plans and Controls
- o Manufacturing
- o Inspection and Test
- o Equipment and Tools
- o Facilities
- o Industrial Support
- o Personnel and Training
- o Control Data

11. FUNDING

11.1 INTRODUCTION

Successful production planning requires management attention to the interface between the production elements' funding requirements and defense budgeting and financing. The production funding element should be closely interfaced with the system design funding element and the logistic support funding element throughout the equipment life cycle. These funding elements should be included as part of the overall program budgeting and financing activities and should require the:

- Early determination of production funding estimates which, together with the experience factors from similar production programs, allow accurate forecasting of the equipment life cycle costs;
- Accurate updating of forecasts for timely fiscal planning and apportionment of required research and development, investment, and production funds;
- Allocation of available program funds to each production element based upon the justified need, with emphasis given to schedule balance and task priorities;
- Accurate accounting of funds expenditures using work breakdown structure and measurement criteria to insure the proper use and redistribution of funds; and
- Schedule flexibility in case of budget changes.

Essential to the control of funds for the production program is the establishment of a cost control system which, as part of

production plans and controls (Chapter 4), can maintain adequate cost and schedule balance among all elements. Figure 6 and the following paragraphs describe the direct relationships which should exist among the funding and other production elements.

11.2 DETAILED EVENT DESCRIPTION

F-2 PROVIDE FUNDING ESTIMATE (PRELIMINARY)

Preliminary funding estimates for concept formulation are made. They are based on the effort needed to establish production concepts and requirements not currently in being. The estimates should include funding for all production planning studies; exploratory development of machine tools or other such items requiring state-of-the-art advancement; and preparation of production plan requirements. Based on cost experience data (PM-2), preliminary production funding estimates are made. Criteria are established for further definition of these estimates and the range of flexibility that is desired.

F-5 DEVELOP FUNDING SCHEDULE AND PLAN REQUIREMENTS

Funding schedule and plan requirements are developed for inclusion with the production plan requirements (PM-5). These requirements are based upon the selected production concepts (PM-4) and an estimate of each production element's budgeting and financing needs for the definition, development, production, and operational phases. Definitive estimates of the funding requirements for definition phase production planning activities are made. Work breakdown structures with line item cost estimates for each element are required. Due consideration is given to appropriate fiscal budget cycles, schedules, and trade-offs.

These requirements, as part of PM-5, are essential to "Key Approval Action" (SD-5).

F-6 ALLOCATE FUNDS FOR DEFINITION PHASE

Funds for production element participation in contract definition are allocated in accord with the approved development plan and production requirements (SD-6A and B). Their allocation also should be in accord with the funding schedule requirements established in F-5.

F-7 PREPARE FINANCIAL PLAN FOR PRODUCTION (EXPERIMENTAL)

Production element funding plans should be prepared at all levels of management. These plans delineate the distribution of funds (F-6) for all task efforts. Consideration is given to both government and contract cost, with separate categories for each, as required. Production management reviews and approves this plan for incorporation into the equipment program financial plan.

F-8A UPDATE FINANCIAL PLAN

New production requirements resulting from the evaluation of the proposals (PM-8) are the basis for updating the financial plan. Estimated funding needs are evaluated and previous budgets are refined to more accurately reflect future demands. Reasons for changes should be evaluated to determine their validity and general application for future planning.

F-8B CONFIRM AVAILABILITY OF FUNDS

The financial plan for experimental production (F-8A) is compared to actual fund authorizations for their adequacy to support the program. Funding deficiencies or excesses must be

identified. In particular, expected production program risks due to insufficient funding are documented. The deficiencies, their cause, and resulting risk areas are coordinated for project management review prior to submitting the production development plan (PM-9) for "Key Approval Action" (SD-9A).

F-9 ALLOCATE FUNDS FOR EXPERIMENTAL PRODUCTION AND TESTS

System development approval and contractor selection (SD-9A and B) require allocation of production funds for the development phase. This allocation should be in accord with the funding decisions resolving previously identified problems (F-8B). Funding allocation responsibilities and interfaces should be defined and the funds allocated based upon a work breakdown structure of the tasks to be performed during the development phase. This should include all government/contractor interfaces for the production effort. Because of lead times required for complex manufacturing equipment and tools such as numerical programming equipment, the allocation of funds for those particular items should be adjusted to earlier procurement.

F-12A UPDATE FINANCIAL PLAN (INITIAL PRODUCTION)

The financial plan for production is updated to reflect new requirements stemming from design, support, and production changes (PM-12B). This action depends on contract type, specific funding limits, and the type of change (e.g., contractor or government initiated). The revised plan becomes the baseline for future budgeting and financing activities.

F-12B CONFIRM FUNDS FOR INITIAL PRODUCTION

The updated plan (F-12A) must be reviewed to determine the adequacy of funds authorized for production. Expected program

risks due to insufficient funds are documented. Deficiencies, risk areas, and potential areas for cost reduction are coordinated for review and resolution prior to allocation of the production funds (F-14).

F-14 ALLOCATE FUNDS FOR INITIAL PRODUCTION AND TESTS

Successful test and demonstration of system and equipment prototypes (SD-13 and -14) and verification that all logistics support and production funding requirements have been identified (SM-13 and PM-13) must be accomplished prior to authorization of funds for initial production of system equipment and logistics support resources. These allocated funds must cover all defined resources essential to the production of major, minor, special, and common items to satisfy the system, equipment, and logistics support requirements.

F-15 UPDATE FINANCIAL PLAN (FOLLOW-ON PRODUCTION)

The financial plan for production is updated to reflect any new requirements stemming from changes to the manufacturing processes or other activities during experimental production.

F-16 CONFIRM FUNDS FOR FOLLOW-ON PRODUCTION

Based upon the proposed product baseline established in SD-15, the updated financial plan (F-15) must be reviewed to determine the adequacy of funds authorized for follow-on production. Production management should insure that funding requirements for all production elements are covered by the production contract definition plan (PM-15B). Preliminary estimates of funding requirements from the various proposing contractors should be evaluated to determine the sufficiency of funding.

requirements in the plan. Expected program risks due to insufficient funding should be documented. All deficiencies and risk areas should be coordinated for review and resolution prior to allocation of the production funds (F-17).

F-17 ALLOCATE FUNDS FOR FOLLOW-ON PRODUCTION

Compatibility of specifications for all equipment and supporting resources with the first production article should be assured prior to allocation of funds for follow-on production. This is the responsibility of production management and is essential to Key Approval Action (FM-17E). Participation in the reviews leading to this key approval action is required by both system design and logistics support management personnel. Product baseline approval is the authorization for all follow-on production fiscal funds release.

F-18 CONTINUE FISCAL FUNDING CYCLE

Production management monitors funding requirements and allocations to see that each production element receives and accounts for its share of the funds. Shortages or overages are recorded and adjustments made to the fiscal funding requests or to the program requiring these funds. Work breakdown structure and schedule balancing actions must be accomplished to assure that these fiscal funding requests are properly made and that any deficiencies are immediately made known.

F-21 UPDATE FINANCIAL PLANS FOR PRODUCTION

Changes resulting from service testing or the manufacturing processes require financial plan updating to reflect revised funding requirements. Adjustments in fiscal funding allocations are made based on these approved changes.

F-24A UPDATE FINANCIAL PLAN (MODIFICATIONS) AND CONFIRM FUNDS

Modification cycles may be the result of deficiencies found during suitability testing or subsequent operations (SD-22 to SM-26). Depending on the deficiency, new equipment design or redesign of old equipment may require new production contracts. Preliminary funding estimates for projected equipment and support modification should have been part of the early development phase forecast. These estimates should have been based on production experience with similar systems and should reflect past funding expenditure patterns including times of need during the life cycle period. The plan is updated to provide more accurate estimates of the funds now required for production. The adequacy of authorized funds is then confirmed.

F-24B ALLOCATE FUNDS FOR MODIFICATION

Previously forecasted funds confirmed during the action of F-24A are allocated for any modifications that may be required. Continuous assessment of deficiencies, risk areas, and other specific items which may cause schedule slippage are coordinated and reviewed with appropriate command management personnel. These reviews should include trade-offs among all production element budgets for resolution of these deficiencies within available funding limits. Funding experience based upon the actions to this point is furnished to advanced production planning for incorporation into future production estimates (F-2). Alternative budgeting and financing plans should be prepared to cover any expected future contingency conditions.

C O N T R O L D A T A

Interface Responsibilities:

- o Producibility Specification and Demonstration Data
- o Plans and Controls Analysis, Test, Cost, Change, and Schedule Data
- o Manufacturing Plans, Processes, and Experience Data
- o Inspection and Test Data for Acceptance, Endurance, Destruct, Tolerances, Allowances, Quality Limits, etc.
- o Equipment and Tools Requirements and Use Data
- o Facilities Requirements and Use Data
- o Industrial Support Experience Information
- o Personnel and Training Special Skills Analyses, Demonstration, and Use
- o Funds Requirements, Allocations, Expenditures, and Cost Data

12. CONTROL DATA

12.1 INTRODUCTION

A control data element is essential to the performance, configuration, cost, and schedule control for production of systems and equipment. This element should meet the separate technical and management needs of organizations which have differing production requirements. This control data element is responsible for collecting, programming, and distributing:

- Production engineering analysis documentation;
- Production inspection and test records and reports;
- Schedules and records of milestone achievement;
- Configuration and coding systems for identification of requirements;
- Production effectiveness reporting systems;
- Plant maintenance management and failure data information; and
- Other requirements and forecast information.

Early in development, production management identifies the extent to which the above information systems will be implemented during all phases of the equipment life cycle. Determinations are made as to where, when, how, and by whom the data will be needed. Wherever common usage of these data is essential to both government and contractor, the data and data collection system should be compatible with the current directives. The data should be appropriate to the level of detail, type, complexity,

and cost of the production resources. In some cases, they should be classified as working data. Where different management levels require the use of information in summary form, the requirements should delineate that information by type, depth, and use as appropriate to the management level. When sampling or summary techniques can provide needed information on a one-time or periodic basis, redundant production report processing can be eliminated. The data systems should be oriented to the use of the data to "manage," rather than to the "management of data." Hardware quality, cost, configuration, and schedule control policies also should pertain to the data systems.

Acquisition and operation of new and complex production equipment and tools may justify electronic data processing. Where this approach is used, care should be taken to establish workable interfaces with normal data reporting systems. Care should be exercised to assure that all management levels receiving production summary data as raw tape, cards, etc. have immediate access to compatible processing systems. Trade-off studies should be conducted in advance to determine the advantages of utilizing the new process for the total production effort.

12.2 DETAILED EVENT DESCRIPTION

CD-2 INPUT PRODUCTION EXPERIENCE DATA

Based on the systems and logistics support requirements, qualitative and quantitative production experience data should be provided. Those data should include production experience on similar programs such as:

- Estimates of the current use of production tooling and facilities;

- Current production capability trend forecasts.
- State-of-the-art producibility criteria (machine processing restrictions, numerical tooling capability by location and quantity, etc.);
- Current and forecast critical materials data (e.g., volume, processing times, usage patterns, etc.)
- Industrial support experience (contractor versus organic) based on mission essential needs;
- Techniques, policies, and problems for cost, change, and schedule control; and
- Production concepts, plans, records, and reports common to the system and equipment.

CD-3 PROGRAM ALTERNATIVE PRODUCTION MODELS

Concurrent with the definition of system and support alternatives, preliminary production models are evaluated to the degree necessary for defining concepts and life cycle cost estimates. Data processing of quantitative estimates for facilities, equipment and tools, manpower, and materials may be required. These data should be recorded as justification for concept decisions. The data models may be included in the overall system feasibility studies. They also should be structured to allow ready access to production summary data.

CD-4 ESTABLISH CONTROL DATA CONCEPT

Based upon the production concept selection (PC-4), a preliminary control data concept should be established which will provide a pilot model of the way management data needs are to be satisfied during subsequent definition, development, and production events.

CD-5 PREPARE CONTROL DATA PLAN REQUIREMENTS

The control data element, in coordination with production management, should identify requirements for:

- Production engineering analysis and controls documentation;
- Inspection and test demonstration reporting methods;
- Configuration, schedule balance, and current cost and cost-in-production cost control tracking system;
- Standard production codes and material item identification procedures in support of production management needs;
- Identification of each production management element s specific data needs and outputs;
- Acquiring and evaluating status reports which show achievement of schedules, slippages, shortages of material, equipment and tool items, manpower versus personnel requirements trends, inspections and tests, and summary data to satisfy government/contractor management needs; and
- A production management effectiveness reporting system which will reflect overall progress and problem resolution during high flow production runs.

CD-7A SPECIFY DATA MANAGEMENT REQUIREMENTS

Based on the specific data plan requirements (CD-5), management responsibilities and interfaces should be defined for:

- Collecting and reporting raw data information;

- Collating data for analysis;
- Research and handling of various types of industrial support information;
- Dissemination of data and reports;
- Evaluation and analysis of reported data in the light of knowledge needed by each production element; and
- The reporting of selected production performance for use in future planning.

Definition of the control data plan requirements provides a means for identifying data needs and sources by time, place, and production specialist responsibility.

CD-7B ESTABLISH DATA PLAN EVALUATION CRITERIA

Control data plan evaluation criteria should be established to rate contractor proposals in response to the data portion of the bid package. The data plan should be evaluated for adequacy, currency, simplicity, and validity. The criteria should provide for comparison evaluations of how each specific production element will implement data collection, dissemination, and use tasks and responsibilities. Evaluation should also consider plans for furnishing and collecting data to and from subcontractor and project offices. Consideration should be given to communication, proprietary, and security limitations.

CD-8 EVALUATE DATA PLAN PROPOSALS

Data plan proposals from each contractor will be evaluated in accordance with the criteria specified in CD-7B.

CD-9 APPROVE CONTROL DATA PLAN

Approval of the control data plan consists of a combined contractor/project management review and sign-off of individual and interfacing data responsibilities. This review must insure a clear understanding of terms, conditions, and definitions. It is a part of the negotiations preliminary to award of the development contract. The control data plan should also consider a method for retrieval and feedback of data information to block CD-2 for future planning.

CD-10A PROGRAMMING OF PRODUCTION ENGINEERING DATA

Beginning with the use of preliminary research and development documentation representing designs that have not yet been fully stabilized, production engineering information and manufacturing and test information are progressively incorporated into a documentation system which allows complete configuration, schedule balance, and cost control of all future activities. Where computer processing innovations allow, specification, design, and manufacturing processes information should be programmed directly into that system. Means of extracting and summarizing management data must be provided in accordance with the requirements and criteria previously established (CD-9). To the degree practical, all data required to support the production elements should be included in one set of documentation or within a single data processing system. Control of each element of these data, however, may be based upon an analysis of what organization needs what data element for what use.

CD-10B ESTABLISH STANDARD PRODUCTION CODES

In accordance with overall standard system/equipment/support codes, a set of common production codes should be established in

terms of work elements which are assigned to cover:

- Production engineering analysis control systems;
- Manufacturing, industrial support, and inspection and test management systems;
- Production performance demonstration evaluations; and
- Production materiel items and personnel systems.

Codes are developed in accordance with DoD methods and standards to assure appropriate commonality in terms of overall system design, support, and production reference.

CD-11 to -14 COLLECT AND ANALYZE EXPERIMENTAL
PRODUCTION TEST DATA

Performance results should be fed back to each production element for evaluation of attainment of the assigned production objectives. Each change in requirements triggers a new evaluation cycle to define the impacts and develop trade-off choices among design, support, and production modifications. Measures of performance for specific manufacturing, inspection, and test actions should be in accordance with the inspection and test criteria previously established and include those factors necessary to maintain quality and cost control. In complex development projects, data services for production engineering analysis documentation can provide the manager with a mechanized system to control and record all changes. In simpler procurements, however, documentation control may be done manually. Data collection should encompass procurement orders, shop orders, delivery notices, acceptance statements, inspection records and reports, and other significant documentation which will establish a continuous chain of recorded events for the maintenance of schedule

balance throughout the production cycle. Use of the data control system during experimental production and test will check out the system before high volume production.

CD-15 UPDATE CONTROL DATA PLAN

Production control data must be evaluated for their effect on subordinate element actions (e.g., data collection, processing, evaluation, and analysis). The control data plan is updated for inclusion in the production contract definition plan (PM-15B) and the product baseline (PM-17B).

CD-16 to 24A COLLECT AND ANALYZE DATA ON INITIAL PRODUCTION UNITS

Beginning with the initial production of systems and equipment for user service and operational suitability tests, data should be collected and analyzed by all production management elements. The data should be in accord with the requirements established by production engineering and analyzed to the performance criteria established by producibility and inspection and test requirements. The data collection and analysis effort should be part of a change control system whose objectives include timely corrective action within schedule milestones and cost control parameters. The data collection and analysis effort should be continuous throughout initial production and should cover all events concerned with manufacturing, test, acceptance, and problem resolution. It should cover production element interactions and management interfaces among project, prime contractors, and subcontractors.

CD-17B EVALUATE PROPOSED PLANS

Contractor proposed data systems are reviewed and evaluated to the criteria established in CD-7B. Conformance to all production management element needs are verified and a control data system selected for follow-on production. Control data services responsibilities and relationships among contractor and military organizations are established to allow for a continuous data flow to future operations and support.

CD-18B to -26 COLLECT AND ANALYZE DATA DURING FOLLOW-ON PRODUCTION

Initiation of follow-on production (PM-17B) is the starting point for collection and analysis of control data to assure continuity for all subsequent production actions while maintaining schedule balance and cost control. Collection, analysis, dissemination, and use of these data is in accord with previously established plans (CD-17B). Lessons learned from the initial production data system are incorporated. To the maximum degree practical the changes should be kept to a minimum and the services continuous and compatible. Experience information should be collected on the phaseover of project and contractor activities to systems support commands. Contingency production plans and experience information should be incorporated for rapid extraction and summary use as part of a production preparedness program.

Element interface data should be collected and analyzed to maintain compatibility among system/support and production management actions during the use and control of all production resources. Summary performance and cost reports, appropriately and selectively applied at all management levels, continue for the balance of production during the equipment's life cycle.

SUPPORT
MANAGEMENT

SYSTEM DESIGN
MANAGEMENT

PRODUCTION
MANAGEMENT

PRODUCTION

PLANS AND
CONTROLS

MANUFACTURING

INSPECTION
AND TEST

EQUIPMENT
AND TOOLS

FACILITIES

MATERIAL
SUPPLY

PERSONNEL
AND TRAINING

FINANCIAL

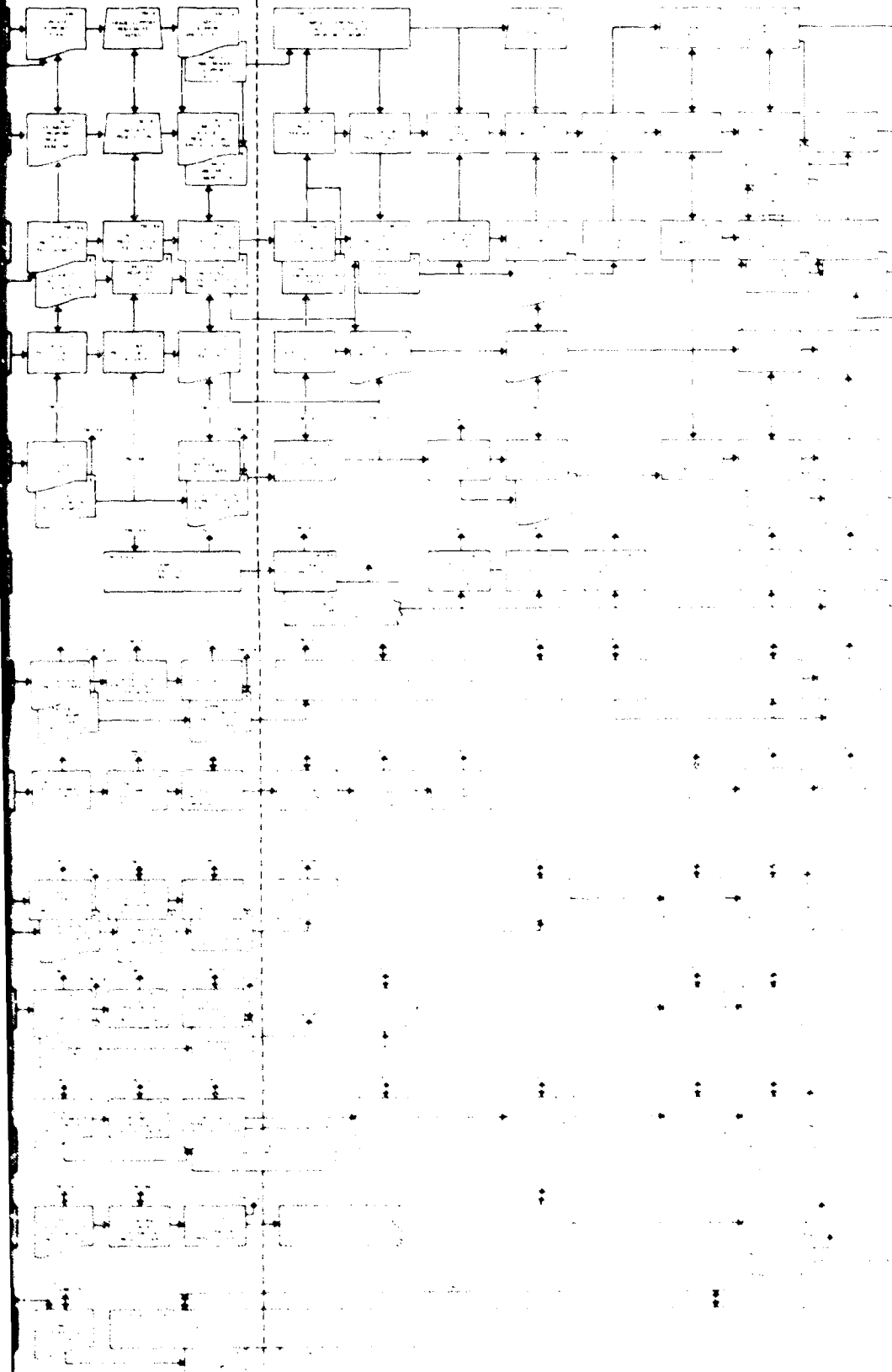
CONTROL DATA

CONCEPT FOR PRODUCTION

J

Figure 1-1

MANAGEMENT MATRIX INTEGRATING PRODUCTION PLANNING EVENTS



OPERATIONAL COMMAND FUNCTIONS

EQUIP FOLLOWING OPERATING UNITS

MISSION ACCOMPLISHED

SYSTEMS SUPPORT COMMAND FUNCTIONS

THE PRODUCTION
OBJECTIVE

MANAGEMENT

MANAGEMENT

MANAGEMENT

UNCLASSIFIED
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13. ABSTRACT <p>This guide describes typical project management activities and key decision points essential to effective production planning for the manufacture, test, delivery, installation, demonstration, and industrial support of DoD systems and equipment. The guide outlines a systems approach to the planning and integration of systems and equipment design, production, and logistics support. It describes typical relationships among project management and subordinate elements throughout the equipment life cycle.</p> <p>The guide is intended for use by production specialists and other interfacing program personnel. While the guide is not intended to be incorporated in a contract, it does provide a checklist of contract considerations for both government and industry planning. It is designed to assist production managers in defining plans, actions, and interfaces tailored to specific programs. Application of the guide depends upon such factors as the mix of existing versus newly designed equipment and the degree of government and industry involvement in various phases of a program.</p>		

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